THE HISTORY OF ANIMALS

By

Aristotle

Book1

Of the parts of animals some are simple: to wit, all such as divide into parts uniform with themselves, as flesh into flesh; others are composite, such as divide into parts not uniform with themselves, as, for instance, the hand dose not divide into hands nor face into faces.

And such as these, some are called not parts merely, but limbs or members. Such are those parts that, while entire in themselves, have within themselves other diverse parts: as for instance, the head, foot, hand, the arm as whole, the chest; for these are all in themselves entire parts, and there are other diverse parts belonging to them.

All those parts that do not subdivide into parts uniform with themselves are composed of parts that do so subdivide, for instance, hand is composed of flesh, sinews, and bons. Of animals, some resemble one another in all their parts, while others have parts wherein, they differ.

Sometimes the parts are identical in form or spices, as, for instance, one man's nose or eye resemble another man's nose or eye, flesh flesh, and bone bone; and in like manner with a horse, and with all other animals which we reckon to be of one and the same species: for as the whole is to the whole, so each to each are the parts severally.

In other case the parts are identical, save only for a difference in the way of excess or defect, as is the case in such animals as are of one and the same genus.

By 'genus' I mean, for instance, Bird or fish, for each of these is subject to difference in respect of its genus, and there are many spices of fishes and of birds.

Within the limits of genera, most of the parts as a rule exhibit differences through contrast of the property or accident, such as colour and shape, to which they are subject: in that some are more and some in a less degree the fewness, magnitude or parvitude, in short in the way of excess or defect.

Thus, in some the texture of the flesh is soft, in others firm; some have a long bill, others are a short one; some have abundance of feathers, others have only a small quantity.

It happens further that some have parts that others have not; but as a general rule, most parts and those that go to make up the bulk to the body are either identical with one another, or differ from one another in the way of contrast and of excess and defect. For 'the more' and 'the less' may be represented as 'excess' or 'defect'.

Once again, we may have to do with animals whose parts are neither identical in form not yet identical save for differences in the way of excess or defect: but they are the same only in the way of analogy, as, for instance, bone is only analogous to fish-bone,

nail to hoof, hand to claw, and scale to feather; for what feather is in bird, the scale is in a fish.

The parts, then, which animals severally possess are diverse from, or identical with, one another in the fashion above described. And they are so furthermore in the way of local disposition: for many animals have identical organs that differ in position; for instance, some have teats in the breast, other close to the thighs.

Of the substances that are composed of parts uniform (or homogeneous) with themselves, some are soft and moist, others are dry and solid. The soft and moist are such either absolutely or so long as they are in their natural conditions, as, for instance, blood, serum, lard, suet, marrow, sperm, gall, milk in such as have it flesh and the like; and also, in a different way, the superfluities, as phlegm and the excretions of the belly and the bladder.

The dry and solid are such as sinew, skin, vein, hair, bone, gristle, nail, horn (a term which as applied to the part involves an ambiguity, since the whole also by virtue of its form in designated horn), and such parts as present an analogy to these.

Animals differ from one another in their mode of subsistence, in their actions, in their habits, and in their parts. Concerning these differences, we shall first speak in broad and general terms, and subsequently we shall treat of the same with close reference to each particular genus.

Differences are manifested in modes of subsistence, in habits, in actions performed. For instance, some animals live in water and others live on Land.

And of those that live in water some dose so in one way, and some in another: that is to say, some live and feed in the water, take in and emit water, and cannot live if deprived of water, as is the case with the great majority of fishes; others get their food and spend their days in the water, but do not take in water but air, nor do they bring forth in the water. Many of these creatures are furnished with feet, as the otter, the beaver, and the crocodile; some are furnished with wings, as the diver and the grebe; some are destitute of feet, as the water-snake.

Some creatures get their living in the water and cannot exist outside it: but for all that do not take in either air or water, as, for instance, the sea-nettle and the oyster. And of creatures that live in the water some live in the sea, some in rivers, some in lakes, and some in marshes, as the frog and newt.

Of animals that live on dry land some take air and emit it, which phenomena are termed ‘inhalation’ and ‘exhalation’; as, for instance, man and all such land animals as are furnished with lungs. Others, again, do not inhale air, yet live and find their sustenance on dry land; as, for instance, the wasp, the bee, and all other insects. And by ‘insects’ I

mean such creatures as have nicks or notches on their bodies, either on their bellies or on both backs and bellies.

And the land animals many, as has been said, derive their subsistence from the water; but of creatures that live in the land inhale water not a single one derives its subsistence from dry land.

Some animals at first live in water, and by the change their shape and live out of water, as is the case with river worms, for out of these the gadfly develops.

Furthermore, some animals are stationary, and some are erratic. Stationary animals are found in water, but no such creature is found on dry land. In the water are many creatures that live in close adhesion to an external object, as is the case with several kinds of oyster. And, by the way, the sponge appears to be endowed with a certain sensibility: as a proof of which it is alleged that the difficulty in detaching it from its moorings is increases if the movement to detach it to be not covertly applied.

Other creatures adhere at one time to an object and detach themselves from it at other times, as is the case with a species of the so-called sea-nettle; for some of these creatures seek their food in the night-time loose and unattached.

Many creatures are unattached but motionless, as is the case with oysters and the so-called holothurian. Some can swim, as, for instance, fishes, molluscs, and crustaceans, such as the crawfish. But some if these last lives in water, to move by walking.

Of the land animals some are furnished with wings, such as birds and bees, and these are so furnished in different ways one from another; others are furnished with feet. Of the animals that are furnished with feet some walk, some creep, and some wriggle. But no creature is able only to move by flying, as the fish is able only to swim, for the animals with leathern wings can walk; the bat has feet and seal has imperfect feet.

Some birds have feet of little power, and are therefore called Apodes. This little bird is powerful on the wing; and as a rule, birds that resemble it are weak-footed and strong winged, such as the swallow and the drepanis or alpine swift; for all these birds resemble one another in their habits and in their plumage, and may easily be mistaken one for another.

(The apus is to be seen at all seasons, but the drepanis only after rainy weather in summer; for this is the time when it is seen and captured, though, as a general rule, it is a rare bird.)

Again, some animals move by walking on the ground, as well as by swimming in water.

Furthermore, the following differences are manifest in their modes of living, and in their actions. Some are gregarious, some are solitary, whether they be furnished with feet or

wings or be fitted for a life in the water; and some partake of both characters, the solitary and the gregarious.

And of the gregarious, some are disposed to combine for social purposes, others to live each for its own self.

Gregarious creatures are, among birds, such as the pigeon, the crane, and the swan; and by the way, no bird furnished with crooked talons is gregarious, of creatures that live in water many kinds of fishes are gregarious, such as the so-called migrants, the tunny, the pelamys, and the bonito.

Man, by the way presents a mixture of the two characters, the gregarious and the solitary.

Social creatures are such as have some one common object in view; and this property is not common to all to all creatures that are gregarious. Such social creatures are man, the bee, the wasp, the ant, and the crane.

Again, of these social creatures some submit to ruler, whereas ants and numerous other creatures are everyone his own master.

And again, both of gregarious and the solitary animals, some are attached to a fixed home and others are erratic or nomad.

Also, some are carnivorous, some omnivorous: whilst some feed on a peculiar diet, as for instance the bees and the spiders, for the bees lives on honey and certain other sweets, and the spider lives by catching flies; and some creatures live on fish.

Again, some creatures catch their food, others treasure it up; whereas others do not so.

Some creatures provide themselves with a dwelling, others go without one; of the former kind are the mole, the mouse, the ant, the bee; of the latter kind are many insects and quadrupeds. Further, in respect to locality of the dwelling place, some creatures dwell underground, as the lizard and the snake; others live on the surface of the ground, as the horse and the dog, make to themselves holes, others do not.

Some are nocturnal, as the owl and the bat; others live in the daylight.
Moreover, some creatures are tame and some are wild: some are at all times tame, as man and the mule: others are at all times savage, as the leopard and the wolf; and some creatures can be rapidly tamed, as the elephant.

Again, we may regard animals in another light. For, whenever a race of animals is found domesticated, the same is always to be found in a wild condition; as we find to be the case with horses, kine, swine, (men), sheep, goats, and dogs.

Further, some animals emit sound while others are mute, and some are endowed with voice: of these latter some have articulate speech, while, others are inarticulate; some are given to continual chirping and twittering, some are prone to silence; some are musical, and some unmusical; but all animals without exception exercise their power of singing or chattering chiefly in connexion with the intercourses of the sexes.

Again, some creatures live in the fields, as the cushat; some on the mountains, as the hoopoe; some frequent the abodes of men, as the pigeon.

Some, again, are peculiarly salacious, as the partridge, the barn-door cock and their congeners; others are inclined to chastity, as the whole tribe of crows, for birds, of this kind indulge but rarely in sexual intercourse.
Of marine animals, again, some live in the open seas, some near the shore, some on rocks.

Furthermore, some are combative under offence; others are provident for defence. Of the former kind are such as act as aggressors upon others or retaliate when subjected to ill usage, and of the latter kind are such as merely have some means of guarding themselves against attack.

Animals, also differ from one another in regard to character in the following respects. Some are good-tempered, sluggish, and little prone to ferocity, as the ox; others are quick tempered, ferocious and unteachable, as the wild boar; some are intelligent and timid, as the stag and the hare; others are mean and treacherous, as the snake; others are noble and courageous and high-bred, as the lion; others are thorough-bred and wild and treacherous, as the wolf; for, by the way, an animal is highbred if it come from a noble stock, and an animal is thorough-bred if it does not deflect from its racial characteristics.

Further, some are crafty and mischievous, as the fox; some are spirited and affectionate and fawning, as the dog; others are easy-tempered and easily domesticated, as the elephant; others are cautious and watchful, as the goose; other are jealous and self-conceited, as the peacock. But of all animals man alone is capable of deliberation.

Many animals have memory, and are capable of instruction; but no other creature except man can recall the past at will.
With regard to the several genera of animals, particulars as their habits of life and modes of existence will be discussed more fully by and by.

2

Common to all animals are the organs whereby they take food and the organs where into they take it; and these are either identical with one another, or are diverse in the ways above specified: to wit, either identical in for, or varying in respect of excess or defect, or resembling one another analogically, or differing in position.

Furthermore, the great majority of animals have other organs besides these in common, whereby they discharge the residuum of their food: I say, the great majority, for this statement does not apply to all. And, by the way, the organ whereby food is taken in is called the mouth, and the organ whereinto it is taken, the belly; the remainder of the alimentary system has great variety of names.

Now the residuum of food is twofold in kind, wet and dry, and such creatures as have organs receptive of wet residuum are invariably found with organs receptive of dry residuum; but such as have organs receptive of dry residuum need not possess organs receptive of wet residuum. In other words, an animal has a bowel and be without a bladder, and, by the way, I many here remark that the organ receptive of dry residuum ‘intestine’ or ‘bowel’.

3

Of animals otherwise, a great many have, beside the organs above-mentioned, an organ for excretion of the sperm: and of animals capable of generation, one secretes into another, and the other into itself. The latter is termed ‘female’, and the former ‘male’; but some animals have neither male nor female. Consequently, the organs connected with this function differ in form, for some animals have a womb and others an organ analogous thereto. The above-mentioned organs, then, are the most indispensable parts of animals; and with some of them all animals without exception, and with others animals for most part, must needs be provided.

One sense, and one alone, is common to all animals-the sense of touch. Consequently, there is no special name for the organ in which it has its seat; for in some groups of animals the organ is identical, in other it is only analogues.

4

Every animal is supplied with moisture, and, if the animal be deprived of the same by natural causes or artificial means, death ensues: further, every animal has another part in which the moisture is contained. These parts are blood and vein, and in other animals there is something to correspond; but in these latter the parts are imperfect, being merely fibre and serum or lymph.

Touch has its seat in a part uniform and homogeneous, as in the flesh or something of the kind, and generally, with animals supplied with blood; but in the parts analogues to

the parts charged with blood; but in all cases it is seated in parts that in their texture are homogeneous.

The active faculties, on the contrary, are seated in the parts that are heterogenous: as, for instance, the business of preparing the food is seated in the mouth, and the office of locomotion in the feet, the wings, or in organs to correspond.
Again, some animals are supplied with blood, as man, the horse, and all such animals as are, when full-grown, either destitute of feet, or two-footed, or four-footed; other animals are bloodless, such as the bee and the wasp, and, of marine animals, the cuttle-fish, the crawfish, and all such as have more than four feet.

5

Again, some animals are viviparous, others oviparous, others vermiparous or 'grub-bearing' Some are viviparous, such as man, the horse, the seal, and all other animals that are hair-coated, and, of marine animals, the cetaceans, as tubular air-passage and no gills, as the dolphin, and the so-called Selachia. (Of these latter animals, some have a tubular air-passage and no gills, as the dolphin and the whale: the dolphin with the air-passage going through its back, the whale with air-passage in its forehead; others uncovered gills, as the Selachia, the sharks and rays.)

What we term an egg is a certain completed result of conception out of which the animal that is to be develops, and in such a way that in respect to its primitive germ it comes from part of the egg, while the rest serves for food as the germ develops. A 'grub' on the other hand is a thing out of which in its entirety the animal in its entirety develops, by differentiation and growth of the embryo.

Of viviparous animals, some hatch eggs in their own interior, as creatures of the shark kind; others engender in their interior live foetus, as man and the horse. When the result of conception is perfected, with some animals a living creature is brought forth, with others an egg is brought to light, with others a grub. Of the egg, some have egg-shell and are of two different colours within, such as birds 'eggs; others are soft-skinned and uniform colour, as the eggs of animals of the shark kind. Of the grubs, some are from the first capable of movement, others are motionless. However, with regard to these phenomena we shall speak precisely hereafter when we come to treat of Generations.

Furthermore, some animals have feet and some are destitute thereof. Of such as have feet some animals have two, as is the case with men and birds, and with men and birds only, some have four, as the lizard and the dog; some have more, as the centipede and the bee; but all-over that have feet have an even number of them.

Of swimming creatures that are destitute of feet, some have winglets or fins, as fishes: and of these some have four fins, two above on the back, two below on the belly, as the gilthead and basse; some have two only, -to wit, such as are exceedingly long and

smooth, as the eel and the conger; some have none at all, as the moray eel, but use the sea just as snakes use dry ground- and by the way, snakes swim in water in just the same way. Of the shark-kind some have no fins, such as those are flat and long-tailed, as the ray and the sting-ray, but these fishes swim actually by the undulatory motion of their flat bodies; the fishing frog, however, has fins, and so likewise have all such fishes have not their flat surfaces thinned off to a sharp edge.

Of these swimming creatures that appear to have feet, as is the case with the molluscs, these creatures swim by the aid of their feet and their fins as well, and they swim most rapidly backwards in the direction of the trunk, as is the case with the cuttle-fish or sepia and the calamar; by the way, neither of these latter can walk as the octopus or octopus can.

The hard-skinned or crustaceous animals, like the crawfish, swim by the instrumentality of their tail-parts, and they swim most rapidly tail foremost, by the aid of the fins developed upon that member. The newt swims by means of its feet and tails; and it tails resembles that of the sheatfish, to compare with little with great.

Of animals that can fly some are furnished with feathered wings, as the eagle and hawk, some are furnished with membranous wings, as the bee and the cockchafer; others are furnished with leathern wings, as the flying fox and the bat. All flying creatures possessed of blood have feathered wings or leathern wings, the bloodless creatures have membranous wings, as insects. The creatures that have feathered wings or leathern wings have either two feet or no feet at all: for there are said to be certain flying serpents in Ethiopia that are destitute of feet.
Creatures that have feathered wings are classed as genus under the name of ‘bird’; the other two genera, the leathern-winged and membrane-winged, are as yet without a genetic title.

Of creatures that can fly and are bloodless some are coleopterous or sheath-winged, for they have their wings in a sheath or shard, like the cockchafer and the dung-beetle; others are sheath-less, and of these latter some are dipterous and some tetrapetalous: tetrapetalous, such as are comparatively large or have their stings in the tail, dipterous, such as are comparatively small or have their stings in front. The coleoptera are, without exception, devoid of stings; the Diptera have the sting in front, as the fly, the horsefly, the gadfly, and the gnat.

Bloodless animals as general rule is inferior in point of size to blooded animals; though, by the way, there are found in the sea some few bloodless creatures of abnormal size, as in the case of certain molluscs. And of these bloodless genera, those are largest than dwell in milder climates, and those inhabit the sea are larger than those living on dry land or in fresh water.

All creatures that are capable of motion move with four or more points of motion; the blooded animals with four only: as, for instance, man with two hands and two feet, birds with two wings and two feet, quadrupeds and fishes severally with four feet and four

fins. Creatures that have two winglets or fins, or that have none at all like serpents, move all the same with not less than four points of motion; for there are four bends in their bodies as they move, or two bends together with their fins, bloodless and many footed animals, whether furnished with wings or feet, move with four feet and four points of motion; as, for instance, the dayfly moves with four feet and four wings: and, I may observe in passing, this creature is exceptional not only in regard to the duration of its existence, whence it receive its name but also because through a quadruped it has also, all animals move alike, four-footed and may-footed; in other words, they all move cross-corner-wise. And animals in general have two feet in advance; the crab alone has four.

6

Very extensive genera of animals, into which other subdivisions fall, are the following: one, of birds; one, of fishes; and another, of cetaceans. Now all these creatures are blooded.

There is another genius of the hard-shell kind, which is called oyster; another of the soft-shell kind, not as yet designated by a single term, such as the spiny crawfish and the various kinds of crabs and lobsters; and another of molluscs, as the two kinds of calamary and the cutter-fish; that of insect is different. All these latter creatures are bloodless, and such of them as have feet have a goodly number of them; and of the insects some have wings as well as feet.

Of the other animals the genera are not extensive. For in them one species does not comprehend many species; but in one case, as man, the species is simple, admitting of no differentiation, while other cases admit of differentiation, but the form lack particular designations.

So, for instance, creatures that are quadrupedal and unprovided with wings are blooded without exception, but some of them are viviparous, and some oviparous. Such as are viviparous are hair-coated, and such as are oviparous are covered with a kind of tessellated hard substances; and the tessellated bits of this substance are, as it were, similar in regard to position to scale.

An animal that is blooded and capable of movement on dry land, but is naturally unprovided with feet, belongs to the serpent genus; and animals of this genus are coated with the tessellated horny substance, Serpent in general are oviparous; the adder, an exceptional case, is viviparous: for not all viviparous animals are hair-coated, and some fishes also are viviparous.

All animals, however, that are hair-coated are viviparous. For, by the way, one must regard as kind of hair such prickly hairs as hedgehogs and porcupines carry; for these spines perform the office of hair, and not of feet as is the case with similar parts of sea-urchins.

In the genus that combines all viviparous quadrupeds are many spices, but under no common application. They are only named as it were one by one, as we say man, lion, stag, horse, dog, and so on; though, by the way, there is a sort of genus that embraces all creatures that have bushy manes and bushy tails, such as the horse, the ass, the mule, the jennet, and the animals that are called Hemione in Syria, -from their externally resembling mules, though they are not strictly of the same species. And that they are not so is proved by the fact that they mate with and breed from one another. For all these reasons, we must take animals species by species, and discuss their peculiarities severally'

These preceding statements, then, have been put forward thus in general way, as a kind of foretaste of the number of subjects and of the properties that we have to consider in order that we may first get a clear notion of distinctive character and common properties. By and by we shall discuss these matters with greater minuteness.

After this we shall pass on to the discussion of causes. For to do this when the investigation of the details in complete is the proper and natural method, and that whereby the subjects and the premisses of our argument will afterwards be rendered plain.

In the first we must look to the constituent parts of animals. For it is in a way relative parts, first and foremost, that animals in their entirety differ from one another; either in the fact that some have this or that, while they have not that or this; or by peculiarities of position or of arrangement; or by the differences that have been previously mentioned, depending upon diversity of form, or excess or defect in this or that particular, on analogy, or on contrasts of the accidental qualities.

To begin with, we must take into consideration the parts of Man. For, just as each nation is wont to reckon by that monetary standard with which it is most familiar, so must we do in other matters. And, of course, man is the animal with which we are all of us the most familiar.

Now the parts are obvious enough to physical perception. However, with the view of observing due order and sequence and of combining rational notions with physical perception, we shall proceed of enumerate the parts: firstly, the organic, and afterwards the simple or non-composite.

7

The chief parts into which the body as a whole is subdivided, are the head, the neck, the trunk (extending from the neck to the privy parts), which is called the thorax, two arms and two legs.

Of the parts of which the head is composed the hair-covered portion is called the ‘skull’. The front portion of it is termed ‘bregma’ or ‘sinciput’, developed after birth-for- it is the last of all the bones in the body to acquire solidity; the hinder part is termed the ‘occiput’, and the part intervening between the sinciput and the occiput is the ‘crown’.

The brain lies underneath the sinciput; the occiput is hollow.

The skull consists entirely of thin bone, rounded in shape, and contained within a wrapper of flashness skin.
The skull has sutures: one, of circular form, in the case of women; in the case of men, as a general rule, three meeting at the point. Instances have been known of a man’s skull devoid of structure altogether. In the skull the middle line, where the hair parts, is called crown or vertex. In some cases, the parting is double; that is to say, some men are double crowned, not in regard to the bony skull, but in consequence of the double fall or set of the hair.

8

The part that lies under the skull is called ‘face’: but in the case of man only, for the term is not applied to a fish or to an ox. In the face the part below the sinciput and between they eyes is termed the forehead. When men have large foreheads, they are slow to move; when they have small ones, they are fickle; when they have board ones, they are apt to be distraught;

When thy have foreheads rounded or bulging out, they are quick-tempered.

9

Underneath the forehead are two eyebrows. Straight eyebrows are a sign of softness of disposition; such as curve in toward the nose, of harshness; such as curve out towards the temples, of humour and dissimulation; such as are drawn in towards one another, of jealousy.

Under the eyebrows come the eyes. These are naturally two in number. Each of them has an upper and l lower eyelid, and the hairs on the edges of these termed ‘eyelashes. The central part of the eye includes the moist part whereby vision is affected, termed the ‘pupil’, and the past surrounding it called the ‘black’; the part outside is the ‘white’. A part common to the upper and lower eyelid is a pair of nicks or corners, one in the direction of the nose, and the other in the direction of the temples. When these are long, they are a sign of bad disposition; if the side toward the nostril be fleshy and comb-like, they are a sign of dishonesty.

All animals, as a general rule, are provided with eyes, excepting the ostracoderms and other imperfect creatures; at all events, all viviparous animals have eyes, with the exception of the mole. And yet one might assert that, though the mole has not eyes in the full sense, yet it has in a kind of a way. For in point of absolute fact it cannot see, and has no eyes visible externally, but when the outsider skin is removed, it is removed, it is found to have the place where eyes are usually situated, and the black parts of the eyes rightly situated, and all the place that is usually devoted on the outside to eyes: showing that the parts are stunned in development, and the skin allowed to grow over.

10

Of the eye the white is pretty much the same in all creatures; but what is called black in various animals. Some have the rim black, some distinctly blue, some greyish-blue, some greenish; and this last colour is the sign of an excellent disposition, and is particularly well adapted for sharpness of vision. Man is the only, or nearly the only, creature, that has eyes of diverse colours. Animals, as a rule, have eyes of one colour only.

Some horses have blue eyes.

Of eyes, some are large, some small, some medium-sized; of these, the medium-sized are the best.

Moreover, eyes sometimes protrude, sometimes recede, sometimes are neither protruding nor receding. Of these, the receding eye is in all animals the most acute; but the last kind are the sign of the best disposition. Again, eyes are sometimes inclined to wink under observation, sometimes to remain open and starting, and sometimes are disposed neither to wink nor stare. The last kind are the sign of the best nature, and of the others, the latter kind indicates impudence, and the former indecision.

11

Furthermore, there is a portion of the head, whereby an animal hears, as a part incapable of breathing, the ‘ear’. I say ‘incapable of breathing’, for Alcmaeon is mistaken when he says that goats inspire through their ears. Of the ear one part is unnamed, the other part is called the ‘lobe’; and it is entirely composed of gristle and flesh. The ear is constructed internally like the trumpet-shell, and the innermost bone is like the ear itself, and into it at the end the sound the sound makes its way, as into the bottom of a jar. This receptacle dose not communicate by any passage with the brain, but dose so with the palate, and the vein extended from the brain, and each of them lies at the end of a little vein. Of animals possessed of ears man is the only one that cannot move this organ. Of creatures possessed of hearing, some have ears visible, as, for example, feathered animals or animals coated with horny tessellates.

Viviparous animals, with the exception of the seal, the dolphin, and those others which after a similar fashion to these are cetaceans, are all provided with ears; for, by the way, the shark-kind are also viviparous.

Now the seal has the passages visible whereby it hears; but the dolphin can hear, but has no ears, nor yet any passages visible. But man, alone is unable to move his ears, and all other animals can move them. And the ears lie, with man, in the same horizontal plane with the eyes, and not in a plane above them as is the case with some quadrupeds. Of ears, some are fine, some are coarse, and some are of medium texture; the last kind are best for hearing, but they serve in no way to indicate character. Some ears are large, some small, some medium-sized; again, some stand out far, some lie in close and tight, and some take up a medium position; of these such as are of medium size and of medium position are indications of the best disposition, while the large and outstanding ones indicate a tendency to irrelevant talk or chattering. The part intercepted between the eye, the ear, and the crown is termed the temple'. Again, there is a part of the countenance that serves as a passage for the breath, the 'nose'.

For a man inhales and exhales by this organ, and sneezing is affected by its means: which last is an outward rush of collected breath, and is the only mode of breath used as an omen and regarded as supernatural. Both inhalation and exhalation go right on from the nose towards the chest; and with the nostrils alone and separately it is impossible to inhale or exhale, owing to the fact that the inspiration and respiration take place from the chest along the windpipe, and not by any portion connected with the head; and indeed, it is possible for a creature to live without using this process of nasal respiration.

Again, smelling takes place by means of the nose, -smelling, or the sensible discrimination of odour. And the nostril admits of easy motion, and is not, like the ear, intrinsically immovable. A part of it, composed of gristle, constitutes, a septum or partition, and part is an open passage; for the nostril consists of two separate channels.

The nostril (or nose) of the elephant is long and strong, and the animal uses it like a hand; for by means of this organ it draws objects towards it, and takes hold of them, and introduces its food into its mouth, whether liquid or dry food, and it is the only living creature that does so.

Furthermore, there are two jaws; the front part of them constitutes the chin, and the hinder part the cheek. All animals move the lower jaw, with the exception of the river crocodile; this creature moves the upper jaw only.

Next after the nose come two lips, composed of flesh, and facile of motion.
The mouth lies inside the jaws and lips. Parts of the mouth are the roof or palate and the pharynx.

The part that is sensible of taste is the tongue. The sensation has its seat at the tip of the tongue; if the object to be tasted be placed on the flat surface of the organ, the taste is less sensibly experienced. The tongue is sensitive in all other ways wherein flesh in general is so: that is, it can appreciate hardness, or warmth and cold, in any part of it, just as it can appreciate taste. The tongue is sometimes broad, sometimes narrow, and sometimes of medium width; the last kind is the best and the clearest in its discrimination of taste. Moreover, the tongue is sometimes loosely hung, and sometimes fastened: as in the case of those who mumble and who lisp.

The tongue consists of flesh, soft and spongy, and the so-called 'epiglottis' is a part of this organ.

That part of the mouth that splits into two bits is called the tonsils'; that part that splits into many bits, the ‘gums. Both the tonsils and the gums are composed of flesh. In the gums are teeth, composed of bone.

Inside the mouth is another part, shaped like a bunch of grapes, a pillar streaked with veins. If this pillar gets relaxed and inflamed it is called 'uvula' or 'bunch of grapes', and it then has a tendency to bring about suffocation.

12

The neck is the part between the face and the trunk. Of this the front part is the larynx land the back part the Ur.
The front part, composed of gristle, through which respiration and speech is affected, is termed the 'windpipe'; the part that is fleshy is the oesophagus, inside just in front of the chine. The part to the back of the neck is the epomis, or 'shoulder-point’:

These then are the parts to be met with before you come to the thorax.

To the trunk there is a front part and a back part. Next after the neck in the front part is the chest, with a pair of breasts. To each of the breasts is attached a teat or nipple, through which in the case of females the milk percolates; and the breast is of a spongy texture. Milk, by the way, is found at times in the male; but with the male the flesh of the breast is tough, with the female it is soft and porous.

13

Next after the thorax and in front comes the 'belly', and its root the 'navel'.
Underneath this root the bilateral part is the flank': the undivided part below the navel, the 'abdomen', the extremity of which is the region of the 'pubes'; above the navel the 'hypochondrium'; the cavity common to the hypochondrium and the flank is the gut-cavity.

Serving as a brace girdle to the hinder parts is the pelvis, and hence it gets its name (osphus), for it is symmetrical (isophues) in appearance; of the fundament the part for resting on is termed the 'rump', and the part where on the thigh pivots is termed the 'socket' (or acetabulum).

The 'womb' is a part peculiar to the female; and the 'penis' is peculiar to the male. This latter organ is external and situated at the extremity of the trunk; it is composed of two separate parts: of which the extreme part is fleshy, does not alter in size, and is called the glans; and round about it is a skin devoid of any specific title, which integument if it be cut asunder never grows together again, any more than does the jaw or the eyelid.

And the connexion between the latter and the glans is called the frenum. The remaining part of the penis is composed of gristle; it is easily susceptible of enlargement; and it protrudes and recedes in the reverse directions to what is observable in the identical organ in cats. Underneath the penis are two testicles', and the integument of these is a skin that is termed the 'scrotum'.

Testicles are not identical with flesh, and are not altogether diverse from it.
But by and by we shall treat in an exhaustive way regarding all such parts.

14

The privy part of the female is in character opposite to that of the male. In
other words, the part under the pubes is hollow or receding, and not, like the male organ, protruding. Further, there is a 'urethra' outside the womb; which organ serves as a passage for the sperm of the male, and as an outlet for liquid excretion to both sexes).

The part common to the neck and chest is the 'throat'; the 'armpit is common to side, arm, and shoulder; and the groin' is common to thigh and abdomen. The part inside the thigh and buttocks is the 'perineum', and the part outside the thigh and buttocks is the ‘hypoglutis'.

The front parts of the trunk have now been enumerated.

The part behind the chest is termed the 'back'.

15

Parts of the back are a pair of 'shoulder blades', the 'back-bone', and, underneath on a level with the belly in the trunk, the ‘loins’. Common to the upper and lower part of the trunk are the ribs', eight on either side, for as to the so-called seven-ribbed Lignans we have not received any trustworthy evidence.

Man, then, has an upper and a lower part, a front and a back part, a right and a left side. Now the right and the left side are pretty well alike in their parts and identical throughout, except that the left side is the weaker of the two; but the back parts do not resemble the front ones, neither do the lower ones the upper: only that these upper and lower parts may be said to resemble one another thus far, that, if the face be plump or meagre, the abdomen is plump or meagre to correspond; and that the legs correspond to the arms, and where the upper arm is short the thigh is usually short also, and where the feet are small the hands are small correspondingly.

Of the limbs, one set, forming a pair, is 'arms'. To the arm belong the 'Shoulder', 'upper-arm', 'elbow', fore-arm', and 'hand'. To the hand belong the 'palm', and the five 'fingers'. The part of the finger that bends is termed knuckle', the part that is inflexible is termed the phalanx'. The big finger or thumb is single-jointed, the other fingers are double jointed. The bending both of the arm and of the finger takes place from without inwards in all cases; and the arm bends at the elbow. The inner part of the hand is termed the palm', and is fleshy and divided by joints or lines: in the case of long-lived people by one or two extending rights across, in the case of the short-lived by two, not so extending. The joint between hand and arm is termed the 'wrist'. The outside or back of the hand is sinewy, and has no specific designation.

There is another duplicate limb, the leg'. Of this limb the double-knobbed part is termed the (thigh-bone', the sliding part of the 'kneecap', the double- boned part the 'leg'; the front part of this latter is termed the 'shin', and the part behind it the 'calf', wherein the flesh is sinewy and venous, in some cases drawn upwards towards the hollow behind the knee, as in the case of people with large hips, and in other cases drawn downwards. The lower extremity of the shin is the 'ankle', duplicate in either leg. The part of the limb that contains a multiplicity of bones is the foot'.

The hinder part of the foot is the 'heel'; at the front of it the divided part consists of toes', five in number; the fleshy part underneath is the ball'; the upper part or back of the foot is sinewy and has no particular appellation; of the toe, one portion is the nail' and another the joint', and the nail is in all cases at the extremity; and toes are without exception single jointed. Men that have the inside or sole of the foot clumsy and not arched, that is, that walk resting on the entire under-surface of their feet, are prone to roguery. The joint common to thigh and shin is the 'knee'.

These, then, are the parts common to the male and the female sex.

The relative position of the parts as to up and down, or to front and back, or to right and left, all this as regards externals might safely be left to mere ordinary perception. But for all that, we must treat of them for the same reason as the one previously brought forward; that is to say, we must refer to them in order that a due and regular sequence may be observed in our exposition, and in order that by the enumeration of these obvious facts due attention may be subsequently given to those parts in men and other animals that are diverse in any way from one another.

In man, above all other animals, the terms 'upper' and lower' are used in harmony with their natural positions; for in him, upper and lower have the same meaning as when they are applied to the universe as a whole. In like manner the terms, fin front', 'behind', 'right' and left', are used in accordance with their natural sense.
But in regard to other animals, in some cases these distinctions do not exist, and in others they do so, but in a vague way.
For instance, the head with all animals is up and above in respect to their bodies; but man alone, as has been said, has, in maturity, this part uppermost in respect to the material universe.

Next after the head comes the neck, and then the chest and the back: the one in front and the other behind. Next after these come the belly, the loins, the sexual parts, and the haunches; then the thigh and shin; and, lastly, the feet.

The legs bend frontwards, in the direction of actual progression, and frontwards also lies that part of the foot which is the most effective of motion, and the flexure of that part; but the heel lies at the back, and the anklebones lie laterally, earwise.

The arms are situated to right and left, and bend inwards: so that the convexities formed by bent arms and legs are practically face to face with one another in the case of man.

As for the senses and for the organs of sensation, the eyes, the nostrils, and the tongue, all alike are situated frontwards; the sense of hearing, and the organ of hearing, the ear, is situated sideways, on the same horizontal plane with the eyes.

The eyes in man are, in proportion to his size, nearer to one another than in any other animal.

Of the senses man has the sense of touch more refined than any animal, and so also, but in less degree, the sense of taste; in the development of the other senses, he is surpassed by a great number of animals.

16

The parts, then, that are externally visible are arranged in the way above stated, and as a rule have their special designations, and from use and wont are known familiarly to all; but this is not the case with the inner parts.

For the fact is that the inner parts of man are to a very great extent unknown, and the consequence is that we must have recourse to an examination of the inner parts of other animals whose nature in any way resembles that of man.

In the first place then, the brain lies in the front part of the head. And this holds alike with all animals possessed of a brain; and all blooded animals are possessed thereof, and, by the way, molluscs as well. But, taking size for size of animal, the largest brain, and the moistest, is that of man.

Two membranes enclose it: the stronger one near the bone of the skull; the inner one, round the brain itself, is finer. The brain in all cases is bilateral. Behind this, right at the back, comes what is termed the 'cerebellum', differing in form from the brain as we may both feel and see.

The back of the head is with all animals empty and hollow, whatever be its size in the different animals. For some creatures have big heads while the face below is small in proportion, as is the case with round-faced animals; some have little heads and long jaws, as is the case, without exception, among animals of the mane-and-tail species.

The brain in all animals is bloodless, devoid of veins, and naturally cold to the touch; in the great majority of animals, it has a small hollow in its centre.

The brain-caul around it is reticulated with veins; and this brain-caul is that skin-like membrane which closely surrounds the brain.

Above the brain is the thinnest and weakest bone of the head, which is termed or 'sinciput'.

From the eye there go three ducts to the brain: the largest and the medium- sized to the cerebellum, the least to the brain itself; and the least is the one situated nearest to the nostril. The two largest ones, then, run side by side and do not meet; the medium-sized ones meet-and this is particularly visible in fishes, for they lie nearer than the large ones to the brain; the smallest pair are the most widely separate from one another, and do not meet.

Inside the neck is what is termed the oesophagus (whose other name is derived oesophagus from its length and narrowness), and the windpipe. The windpipe is situated in front of the oesophagus in all animals that have a windpipe, and all animals have one that are furnished with lungs.

The windpipe is made up of gristle, is sparingly supplied with blood, and is streaked all round with numerous minute veins; it is situated, in its upper part, near the mouth, below the aperture formed by the nostrils into the mouth-an aperture through which, when men, in drinking, inhale any of the liquid, this liquid finds its way out through the nostrils. In betwixt the two openings comes the so-called epiglottis, an organ capable of being drawn over and covering the orifice of the windpipe communicating with the mouth; the end of the tongue is attached to the epiglottis. In the other direction the windpipe extends to the interval between the lungs, and hereupon bifurcates into each of the two divisions of the lung; for the lung in all animals possessed of the organ has a tendency to be double.

In viviparous animals, however, the duplication is not so plainly discernible in other species, and the duplication is least discernible in man. And in man the organ is not split into many parts, as is the case with some vivipara, neither is it smooth, but its surface is uneven.

In the case of the ovipara, such as birds and oviparous quadrupeds, the two parts of the organ are separated to a distance from one another, so that the creatures appear to be furnished with a pair of lungs; and from the windpipe, itself single, there branch off two separate parts extending to each of the two divisions of the lung. It is attached also to the great vein and to what is designated the 'aorta'. When the windpipe is charged with air, the air passes on to the hollow parts of the lung.

These parts have divisions, composed of gristle, which meet at an acute angle; from the divisions run passages through the entire lung, giving off smaller and smaller ramifications.
The heart also is attached to the windpipe, by connexions of fat, gristle, and sinew; and at the point of juncture there is a hollow. When the windpipe is charged with air, the entrance of the air into the heart, though imperceptible in some animals, is perceptible enough in the larger ones. Such are the properties of the windpipe, and it takes in and throws out air only, and takes in nothing else either dry or liquid, or else it causes you pain until you shall have coughed up whatever may have gone down.

The oesophagus communicates at the top with the mouth, close to the windpipe, and is attached to the backbone and the windpipe by membranous ligaments, and at last finds its way through the midriff into the belly. It is composed of flesh-like substance, and is elastic both lengthways and breadthways.

The stomach of man resembles that of a dog; for it is not much bigger than the bowel, but is somewhat like a bowel of more than usual width; then comes the bowel, single, convoluted, moderately wide. The lower part of the gut is like that of a pig; for it is broad, and the part from it to the buttocks is thick and short. The caul, or great omentin, is attached to the middle of the stomach, and consists of a fatty membrane, as is the case with all other animals whose stomachs are single and which have teeth in both jaws.

The mesentery is over the bowels; this also is membranous and broad, and turns to fat. It is attached to the great vein and the aorta, and there run through it a number of veins closely packed together, extending towards the region of the bowels, beginning above and ending below.

So much for the properties of the oesophagus, the windpipe, and the stomach.

17

The heart has three cavities, and is situated above the lung at the division of the windpipe, and is provided with a fatty and thick membrane where it fastens on to the great vein and the aorta.

It lies with its tapering portion upon the aorta, and this portion is similarly situated in relation to the chest in all animals that have a chest. In all animals alike, in those that have a chest and in those that have none, the apex of the heart points forwards, although

this fact might possibly escape notice by a change of position under dissection. The rounded end of the heart is at the top. The apex is to a great extent fleshy and close in texture, and in the cavities of the heart are sinews. As a rule, the heart is situated in the middle of the chest in animals that have a chest, and in man it is situated a little to the left-hand side, leaning a little way from the division of the breasts towards the left breast in the upper part of the chest.

The heart is not large, and in its general shape it is not elongated; in fact, it is somewhat round in form: only, be it remembered, it is sharp-pointed at the bottom. It has three cavities, as has been said: the right-hand one the largest of the three, the left-hand one the least, and the middle one intermediate in size.

All these cavities, even the two small ones, are connected by passages with the lung, and this fact is rendered quite plain in one of the cavities. And below, at the point of attachment, in the largest cavity there is a connexion with the great vein (near which the mesentery lies); and in the middle one there is a connexion with the aorta.

Canals led from the heart into the lung, and branch off just as the windpipe does, running all over the lung parallel with the passages from the windpipe.

The canals from the heart are uppermost; and there is no common passage,
but the passages through their having a common wall receive the breath and pass it on to the heart; and one of the passages conveys it to the right cavity, and the other to the left.

With regard to the great vein and the aorta we shall, by and by, treat of them together in a discussion devoted to them and to them alone. In all animals that are furnished with a lung, and that are both internally and externally viviparous, the lung is of all organs the most richly supplied with blood; for the lung is throughout spongy in texture, and along by every single pore in it go branches from the great vein.

Those who imagine it to be empty are altogether mistaken; and they are led into their error by their observation of lungs removed from animals under dissection, out of which organs the blood had all escaped immediately after death.

Of the other internal organs, the heart alone contains blood. And the lung has blood not in itself but in its veins, but the heart has blood in itself; for in each of its three cavities it has blood, but the thinnest blood is what it has in its central cavity.

Under the lung comes the thoracic diaphragm or midriff, attached to the ribs, the hypochondria and the backbone, with a thin membrane in the middle of it. It has veins running through it; and the diaphragm in the case of man is thicker in proportion to the size of his frame than in other animals.

Under the diaphragm on the right-hand side lies the liver, and on the left-hand side the ‘spleen', alike in all animals that are provided with these organs in an ordinary and not

preternatural way; for, be it observed, in some quadrupeds these organs have been found in a transposed position. These organs are connected with the stomach by the caul.

To outward view the spleen of man is narrow and long, resembling the self- same organ in the pig. The liver in the great majority of animals is not provided with a 'gall-bladder'; but the latter is present in some.
The liver of a man is round-shaped, and resembles the same organ in the ox. And, by the way, the absence above referred to of a gall-bladder is at times met with in the practice of augury. For instance, in a certain district of the Chalcidice settlement in Euboea the sheep are devoid of gall-bladders; and in Naxos nearly all the quadrupeds have one so large that foreigners when they offer sacrifice with such victims are bewildered with fright, under the impression that the phenomenon is not due to natural causes, but bodes some mischief to the individual offerors of the sacrifice.

Again, the liver is attached to the great vein, but it has no communication with the aorta; for the vein that goes off from the great vein goes right through the liver, at a point where are the so-called 'portals' of the liver. The spleen also is connected only with the great vein, for a vein extends to the spleen off from it.

After these organs come the 'kidneys', and these are placed close to the backbone, and resemble in character the same organ in kine. In all animals that are provided with this organ, the right kidney is situated higher up than the other. It has also less fatty substance than the left-hand one and is less moist. And this phenomenon also is observable in all the other animals alike.

Furthermore, passages or ducts lead into the kidneys both from the great vein and from the aorta, only not into the cavity. For, by the way, there is a cavity in the middle of the kidney, bigger in some creatures and less in others; but there is none in the case of the seal.

This latter animal has kidneys resembling in shape the identical organ in kine, but in its case the organs are more solid than in any other known creature.
The ducts that lead into the kidneys lose themselves in the substance of the kidneys themselves; and the proof that they extend no farther rests on the fact that they contain no blood, nor is any clot found therein. The kidneys, however, have, as has been said, a small cavity. From this cavity in the kidney there lead two considerable ducts or ureters into the bladder; and others spring from the aorta, strong and continuous.
And to the middle of each of the two kidneys is attached a hollow sinewy vein, stretching right along the spine through the narrows; by and by these veins are lost in either loin, and again become visible extending to the flank.
And these off-branching of the veins terminate in the bladder. For the bladder lies at the extremity, and is held in position by the ducts stretching from the kidneys, along the stalk that extends to the urethra; and pretty well all round it is fastened by fine sinewy membranes, that resemble to some extent the thoracic diaphragm. The bladder in man is, proportionately to his size, tolerably large.

To the stalk of the bladder the private part is attached, the external orifices coalescing; but a little lower down, one of the openings communicates with the testicles and the other with the bladder. The penis is gristly and sinewy in its texture. With it are connected the testicles in male animals, and the properties of these organs we shall discuss in our general account of the said organ.

All these organs are similar in the female; for there is no difference in regard to the internal organs, except in respect to the womb, and with reference to the appearance of this organ I must refer the reader to diagrams in my 'Anatomy'. The womb, however, is situated over the bowel, and the bladder lies over the womb. But we must treat by and by in our pages of the womb of all female animals viewed generally. For the wombs of all female animals are not identical, neither do their local dispositions coincide.

These are the organs, internal and external, of man, and such is their nature and such their local disposition.

Book 2

1

With regard to animals in general, some parts or organs are common to all, as has been said, and some are common only to particular genera; the parts, moreover, are identical with or different from one another on the lines already repeatedly laid down. For as a general rule all animals that are genetically distinct have the majority of their parts or organs different in form or species; and some of them they have only analogically similar and diverse in kind or genus, while they have others that are alike in kind but specifically diverse; and many parts or organs exist in some animals, but not in others.

For instance, viviparous quadrupeds have all a head and a neck, and all the parts or organs of the head, but they differ each from other in the shapes of the parts. The lion has its neck composed of one single bone instead of vertebrae; but when dissected, the animal is found in all internal characters to resemble the dog.

The quadrupedal vivipara instead of arms have forelegs.
This is true of all quadrupeds, but such of them as have toes have, practically speaking, organs analogous to hands; at all events, they use these fore-limbs for many purposes as hands. And they have the limbs on the left-hand side less distinct from those on the right than man.

The fore-limbs then serve more or less the purpose of hands in quadrupeds, with the exception of the elephant. This latter animal has its toes somewhat indistinctly defined, and its front legs are much bigger than its hinder ones; it is five-toed, and has short ankles to its hind feet. But it has a nose such in properties and such in size as to allow of it using the same for a hand. For it eats and drinks by lifting up its food with the aid of this organ into its mouth, and with the same organ it lifts up articles to the driver on its back; with this organ it can pluck up trees by the roots, and when walking through water it spouts the water up by means of it; and this organ is capable of being crooked or coiled at the tip, but not of flexing like a joint, for it is composed of gristle.

Of all animals man alone can learn to make equal use of both hands.

All animals have a part analogous to the chest in man, but not similar to his; for the chest in man is broad, but that of all other animals is narrow.

Moreover, no other animal but man has breasts in front; the elephant, certainly, has two breasts, not however in the chest, but near it.

Moreover, also, animals have the flexions of their fore and hind limbs in directions opposite to one another, and in directions the reverse of those observed in the arms and legs of man; with the exception of the elephant. In other words, with the viviparous quadrupeds the front legs bend forwards and the hind ones backwards, and the concavities of the two pairs of limbs thus face one another.

The elephant does not sleep standing, as some were wont to assert, but it bends its legs and settles down; only that in consequence of its weight it cannot bend its leg on both sides simultaneously, but falls into a recumbent position on one side or the other, and in this position, it goes to sleep. And it bends its hind legs just as a man bends his legs.

In the case of the ovipara, as the crocodile and the lizard and the like, both pairs of legs, fore and hind, bend forwards, with a slight swerve on one side. The flexion is similar in the case of the multipedes; only that the legs in between the extreme ends always move in a manner intermediate between that of those in front and those behind, and accordingly bend sideways rather than backwards or forwards.

But man bends his arms and his legs towards the same point, and therefore in opposite ways: that is to say, he bends his arms backwards, with just a slight inclination inward, and his legs frontwards. No animal bends both its fore-limbs and hind-limbs backwards; but in the case of all animals the flexion of the shoulders is in the opposite direction to that of the elbows or the joints of the forelegs, and the flexure in the hips to that of the knees of the hind-legs: so that since man differs from other animals in flexion, those animals that possess such parts as these move them contrariwise to man.

Birds have the flexions of their limbs like those of the quadrupeds; for, although bipeds, they bend their legs backwards, and instead of arms or front legs have wings which bend frontwards.

The seal is a kind of imperfect or crippled quadruped; for just behind the shoulder-blade its front feet are placed, resembling hands, like the front paws of the bear; for they are furnished with five toes, and each of the toes has three flexions and a nail of inconsiderable size. The hind feet are also furnished with five toes; in their flexions and nails they resemble the front feet, and in shape they resemble a fish's tail.

The movements of animals, quadruped and multiped, are crosswise, or in diagonals, and their equilibrium in standing posture is maintained crosswise; and it is always the limb on the right-hand side that is the first to move. The lion, however, and the two species of camels, both the Bactrian and the Arabian, progress by an amble; and the action so called is when the animal never overpasses the right with the left, but always follows close upon it.

Whatever parts men have in front, these parts quadrupeds have below, in or on the belly; and whatever parts men have behind, these parts quadrupeds have above on their backs. Most quadrupeds have a tail; for even the seal has a tiny one resembling that of the stag. Regarding the tails of the pitheciids we must give their distinctive properties by and by animal All viviparous quadrupeds are hair-coated, whereas man has only a few short hairs excepting on the head, but so far as the head is concerned, he is hairier than any other animal. Further, of hair-coated animals, the back is hairier than the bely, which latter is either comparatively void of hair or smooth and void of hair altogether. With man the reverse is the case.

Man, also has upper and lower eyelashes, and hair under the armpits and on the pubes. No other animal has hair in either of these localities, or has an under eyelash; though in the case of some animals a few straggling hairs grow under the eyelid.

Of hair-coated quadrupeds some are hairy all over the body, as the pig, the bear, and the dog; others are especially hairy on the neck and all round about it, as is the case with animals that have a shaggy mane, such as the lion; others again are especially hairy on the upper surface of the neck from the head as far as the withers, namely, such as have a crested mane, as in the case with the horse, the mule, and, among the undomesticated horned animals, the bison.

The so-called hippelaphus also has a mane on its withers, and the animal called pardon, in either case a thin mane extending from the head to the withers; the hippelaphus has, exceptionally, a beard by the larynx. Both these animals have horns and are cloven-footed; the female, however, of the hippelaphus has no horns.

This latter animal resembles the stag in size; it is found in the territory of the Arachota, where the wild cattle also are found. Wild cattle differ from their domesticated congeners just as the wild boar differs from the domesticated one. That is to say they are black, strong looking, with a hook-nosed muzzle, and with horns lying more over the back. The horns of the hippelaphus resemble those of the gazelle.

The elephant, by the way, is the least hairy of all quadrupeds. With animals, as a general rule, the tail corresponds with the body as regards thickness or thinness of hair-coating; that is, with animals that have long tails, for some creatures have tails of altogether insignificant size.

Camels have an exceptional organ wherein they differ from all other animals, and that is the so-called 'hump' on their back. The Bactrian camel differs from the Arabian; for the former has two humps and the latter only one, though it has, by the way, a kind of a hump below like the one above, on which, when it kneels, the weight of the whole-body rests. The camel has four teats like the cow, a tail like that of an ass, and the privy parts of the male are directed backwards. It has one knee in each leg, and the flexures of the limb are not manifold, as some say, although they appear to be so from the constricted shape of the region of the belly. t has a huckle-bone like that of kine, but meagre and small in proportion to its bulk.

It is cloven-footed, and has not got teeth in both jaws; and it is cloven footed in the following way: at the back there is a slight cleft extending as far up as the second joint of the toes; and in front there are small hooves on the tip of the first joint of the toes; and a sort of web passes across the cleft, as in geese.

The foot is fleshy underneath, like that of the bear; so that, when the animal goes to war, they protect its feet, when they get sore, with sandals.

Of male animals the genitals of some are external, as is the case with man, the horse, and most other creatures; some are internal, as with the dolphin.

With those that have the organ externally placed, the organ in some cases is situated in front, as in the cases already mentioned, and of these some have the organ detached, both penis and testicles, as man; others have penis and testicles closely attached to the belly, some more closely, some less; for this organ is not detached in the wild boar nor in the horse.

The penis of the elephant resembles that of the horse; compared with the size of the animal it is disproportionately small; the testicles are not visible, but are concealed inside in the vicinity of the kidneys; and for this reason, the male speedily gives over in the act of intercourse. The genitals of the female are situated where the udder is in sheep; when she is in heat, she draws the organ back and exposes it externally, to facilitate the act of intercourse for the male; and the organ opens out to a considerable extent.

With most animals the genitals have the position above assigned; but some animals discharge their urine backwards, as the lynx, the lion, the camel, and the hare. Male animals differ from one another, as has been said, in this particular, but all female animals are retromingent: even the female elephant like other animals, though she has the privy part below the thighs.

In the male organ itself there is a great diversity. For in some cases the organ is composed of flesh and gristle, as in man; in such cases, the fleshy part does not become inflated, but the gristly part is subject to enlargement. In other cases, the organ is composed of fibrous tissue, as with the camel and the deer; in other cases, it is bony, as with the fox, the wolf, the marten, and the weasel; for this organ in the weasel has a bone.

When man has arrived at maturity, his upper part is smaller than the lower one, but with all other blooded animals the reverse holds good. By the 'upper' part we mean all extending from the head down to the parts used for excretion of residuum, and by the lower' part else. With animals that have feet the hind legs are to be rated as the lower part in our comparison of magnitudes, and with animals devoid of feet, the tail, and the like.

When animals arrive at maturity, their properties are as above stated; but they differ greatly from one another in their growth towards maturity. For instance, man, when young, has his upper part larger than the lower, but in course of growth he comes to reverse this condition; and it is owing to this circumstance that-an exceptional instance, by the way-he does not progress in early life as he does at maturity, but in infancy creeps on all fours; but some animals, in growth, retain the relative proportion of the parts, as the dog. Some animals at first have the upper part smaller and the lower part larger, and in course of growth the upper part gets to be the larger, as is the case with the bushy-tailed animals such as the horse; for in their case there is never, subsequently to birth, any increase in the part extending from the hoof to the haunch.

Again, in respect to the teeth, animals differ greatly both from one another and from man. All animals that are quadrupedal, blooded and viviparous, are furnished with teeth; but, to begin with, some are double-toothed (or fully furnished with teeth in both jaws), and some are not. For instance, horned quadrupeds are not double-toothed; for they have not got the front teeth in the upper jaw; and some hornless animals, also, are not double toothed, as the camel. Some animals have tusks, like the boar, and some have not.

Further, some animals are saw-toothed, such as the lion, the pard, and the dog; and some have teeth that do not interlock but have flat opposing crowns, as the horse and the ox; and by 'saw-toothed' we mean such animals as interlock the sharp-pointed teeth in one jaw between the sharp-pointed ones in the other. No animal is there that possesses both tusks and horns, nor yet do either of these structures exist in any animal possessed of 'saw-teeth'. The front teeth are usually sharp, and the back ones blunt. The seal is saw-toothed throughout, inasmuch as he is a sort of link with the class of fishes; for fishes are almost all saw-toothed.

No animal of these genera is provided with double rows of teeth. There is, however, an animal of the sort, if we are to believe Ctesias. He assures us that the Indian wild beast called the 'martyrs' has a triple row of teeth in both upper and lower jaw; that it is as big as a lion and equally hairy, and that its feet resemble those of the lion; that it resembles man in its face and ears; that its eyes are blue, and its colour vermilion; that its tail is like that of the land-scorpion; that it has a sting in the tail, and has the faculty of shooting off arrow-wise the spines that are attached to the tail; that the sound of its voice is a something between the sound of a pan-pipe and that of a trumpet; that it can run as swiftly as deer, and that it is savage and a man-eater.

Man sheds his teeth, and so do other animals, as the horse, the mule, and the ass. And man sheds his front teeth; but there is no instance of an animal that sheds its molars. The pig sheds none of its teeth at all.

2

With regard to dogs some doubts are entertained, as some contend that they shed no teeth whatever, and others that they shed the canines, but those alone; the fact being, that they do shed their teeth like man, but that the circumstance escapes observation, owing to the fact that they never shed them until equivalent teeth have grown within the gums to take the place of the shed ones. We shall be justified in supposing that the case is similar with wild beasts in general; for they are said to shed their canines only. Dogs can be distinguished from one another, the young from the old, by their teeth; for the teeth in young dogs are white and sharp-pointed; in old dogs, black and blunt.

3

In this particular, the horse differs entirely from animals in general: for, generally speaking, as animals grow older their teeth get blacker, but the horse's teeth grow whiter with age.

The so-called 'canines' come in between the sharp teeth and the broad or blunt ones, partaking of the form of both kinds; for they are broad at the base and sharp at the tip.

Males have more teeth than females in the case of men, sheep, goats, and swine; in the case of other animals' observations have not yet been made: but the more teeth they have the more long-lived are they, as a rule, while those are short-lived in proportion that have teeth fewer in number.

4

The last teeth to come in man are molars called 'wisdom-teeth', which come at the age of twenty years, in the case of both sexes. Cases have been known in women upwards. of eighty years old where at the very close of life the wisdom-teeth have come up, causing great pain in their coming; and cases have been known of the like phenomenon in men too. This happens, when it does happen, in the case of people where the wisdom-teeth have not come up in early years.

5

The elephant has four teeth on either side, by which it munches its food, grinding it like so much barley-meal, and, quite apart from these, it has its great teeth, or tusks, two in number. In the male these tusks are comparatively large and curved upwards; in the female, they are comparatively small and point in the opposite direction; that is, they look downwards towards the ground. The elephant is furnished with teeth at birth, but the tusks are not then visible.

6

The tongue of the elephant is exceedingly small, and situated far back in the mouth, so that it is difficult to get a sight of it.

7

Furthermore, animals differ from one another in the relative size of their mouths. In some animals the mouth opens wide, as is the case with the dog, the lion, and with all the saw-toothed animals; other animals have small mouths, as man; and others have mouths of medium capacity, as the pig and his congeners.

(The Egyptian hippopotamus has a mane like a horse, is cloven-footed like an ox, and is snub-nosed. It has a huckle-bone like cloven-footed animals, and tusks just visible; it has the tail of a pig, the neigh of a horse, and the dimensions of an ass. The hide is so

thick that spears are made out of it. In its internal organs it resembles the horse and the ass.).

8

Some animals share the properties of man and the quadrupeds, as the ape, the monkey, and the baboon. The monkey is a tailed ape. The baboon resembles the ape in form, only that it is bigger and stronger, more like a dog in face, and is more savage in its habits, and its teeth are more dog-like and more powerful.

Apes are hairy on the back in keeping with their quadrupedal nature, and hairy on the belly in keeping with their human form-for, as was said above, this characteristic is reversed in man and the quadruped-only that the hair is coarse, so that the ape is thickly coated both on the belly and on the back.

Its face resembles that of man in many respects; in other words, it has similar nostrils and ears, and teeth like those of man, both front teeth and molars. Further, whereas quadrupeds in general are not furnished with lashes on one of the two eyelids, this creature has them on both, only very thinly set, especially the under ones; in fact, they are very insignificant indeed. And we must bear in mind that all other quadrupeds have no under eyelash at all.

The ape has also in its chest two teats upon poorly developed breasts. It has also arm like man, only covered with hair, and it bends these legs like man, with the convexities of both limbs facing one another. In addition, it has hands and fingers and nails like man, only that all these parts are somewhat more beast-like in appearance. Its feet are exceptional in kind. That is, they are like large hands, and the toes are like fingers, with the middle one the longest of all, and the under part of the foot is like a hand except for its length, and stretches out towards the extremities like the palm of the hand; and this palm at the after end is unusually hard, and in a clumsy obscure kind of way resembles a heel. The creature uses its feet either as hands or feet, and doubles them up as one doubles a fist. It’s upper-arm and thigh are short in proportion to the forearm and the shin. It has no projecting navel, but only a hardness in the ordinary locality of the navel. Its upper part is much larger than its lower part, as is the case with quadrupeds; in fact, the proportion of the former to the latter is about as five to three. Owing to this circumstance and to the fact that its feet resemble hands and are composed in a manner of hand and of foot: of foot in the heel extremity, of the hand in all else-for even the toes have what is called a 'palm’: - for these reasons the animal is oftener to be found on all fours than upright. It has neither hips, inasmuch as it is a quadruped, nor yet a tail, inasmuch as it is a biped, except nor yet a tail by the way that it has a tail as small as small can be, just a sort of indication of a tail.

The genitals of the female resemble those of the female in the human species; those of the male are more like those of a dog than are those of a man.

9

The monkey, as has been observed, is furnished with a tail. In all such creatures the internal organs are found under dissection to correspond to those of man.
So much then for the properties of the organs of such animals as bring forth their young into the world alive.

10

Oviparous and blooded quadrupeds-and, by the way, no terrestrial blooded animal is oviparous unless it is quadrupedal or is devoid of feet altogether- are furnished with a head, a neck, a back, upper and under parts, the front legs and hind legs, and the part analogous to the chest, all as in the case of viviparous quadrupeds, and with a tail, usually large, in exceptional cases small. And all these creatures are many-toed, and the several toes are cloven apart. Furthermore, they all have the ordinary organs of sensation, including a tongue, with the exception of the Egyptian crocodile.

This latter animal, by the way, resembles certain fishes. For, as a general rule, fishes have a prickly tongue, not free in its movements; though there are some fishes that present a smooth undifferentiated surface where the tongue should be, until you open their mouths wide and make a close inspection.

Again, oviparous blooded quadrupeds are unprovided with ears, but possess only the passage for hearing; neither have they breasts, nor a copulatory organ, nor external testicles, but internal ones only; neither are they hair coated, but are in all cases covered with scaly plates. Moreover, they are without exception saw-toothed.

River crocodiles have pigs' eyes, large teeth and tusks, and strong nails, and an impenetrable skin composed of scaly plates. They see but poorly under water, but above the surface of it with remarkable acuteness. As a rule, they pass the day-time on land and the nighttime in the water; for the temperature of the water is at night-time more genial than that of the open air.

11

The chameleon resembles the lizard in the general configuration of its body, but the ribs stretch downwards and meet together under the belly as is the case with fishes, and the spine sticks up as with the fish. Its face resembles that of the baboon. Its tail is exceedingly long, terminates in a sharp point, and is for the most part coiled up, like a strap of leather. It stands higher off the ground than the lizard, but the flexure of the legs is the same in both creatures. Each of its feet is divided into two parts, which bear the same relation to one another that the thumb and the rest of the hand bear to one another in man. Each of these parts is for a short distance divided after a fashion into toes; on the front feet the inside part is divided into three and the outside into two, on the hind feet the inside part into two and the outside into three; it has claws also on these parts resembling those of birds of prey. Its body is rough all over, like that of the crocodile. Its eyes are situated in a hollow recess, and are very large and round, and are enveloped

in a skin resembling that which covers the entire body; and in the middle a slight aperture is left for vision, through which the animal sees, for it never covers up this aperture with the cutaneous envelope. It keeps twisting its eyes round and shifting its line of vision in every direction, and thus contrives to get a sight of any object that it wants to see. The change in its colour takes place when it is inflated with air; it is then black, not unlike the crocodile, or green like the lizard but black-spotted like the pard. This change of colour takes place over the whole body alike, for the eyes and the tail come alike under its influence. In its movements it is very sluggish, like the tortoise. It assumes a greenish hue in dying, and retains this hue after death. It resembles the lizard in the position of the oesophagus and the windpipe. It has no flesh anywhere except a few scraps of flesh on the head and on the jaws and near to the root of the tail. It has blood only round about the heart, the eyes, the region above the heart, and in all the veins extending from these parts; and in all these there is but little blood after all. The brain is situated a little above the eyes, but connected with them. When the outer skin is drawn aside from off the eye, a something is found surrounding the eye, that gleams through like a thin ring of copper.

Membranes extend well-nigh over its entire frame, numerous and strong, and surpassing in respect of number and relative strength those found in any other animal. After being cut open along its entire length it continues to breathe for a considerable time; a very slight motion goes on in the region of the heart, and, while contraction is especially manifested in the neighbourhood of the ribs, a similar motion is more or less discernible over the whole body. It has no spleen visible. It hibernates, like the lizard.

12

Birds also in some parts resemble the above-mentioned animals; that is to say, they have in all cases a head, a neck, a back, a belly, and what is analogous to the chest. The bird is remarkable among animals as having two feet, like man; only, by the way, it bends them backwards as quadrupeds bend their hind legs, as was noticed previously. It has neither hands nor front feet, but wings-an exceptional structure as compared with other animals. Its haunch-bone is long, like a thigh, and is attached to the body as far as the middle of the belly; so, like to a thigh is it that when viewed separately it looks like a real one, while the real thigh is a separate structure betwixt it and the shin. Of all birds those that have crooked talons have the biggest thighs and the strongest breasts. All birds are furnished with many claws, and all have the toes separated more or less asunder; that is to say, in the greater part the toes are clearly distinct from one another, for even the swimming birds, although they are web-footed, have still their claws fully articulated and distinctly differentiated from one another. Birds that fly high in air are in all cases four-toed: that is, the greater part have three toes in front and one behind in place of a heel; some few have two in front and two behind, as the wryneck.

This latter bird is somewhat bigger than the chaffinch, and is mottled in appearance. It is peculiar in the arrangement of its toes, and resembles the snake in the structure of its tongue; for the creature can protrude its tongue to the extent of four finger-breadths, and then draw it back again.

Moreover, it can twist its head backwards while keeping all the rest of its body still, like the serpent. It has big claws, somewhat resembling those of the woodpecker. Its note isa shrill chirp.

Birds are furnished with a mouth, but with an exceptional one, for they have neither lips nor teeth, but a beak. Neither have they ears nor a nose, but only passages for the sensations connected with these organs: that for the nostrils in the beak, and that for hearing in the head. Like all other animals they all have two eyes, and these are devoid of lashes. The heavy-bodied (or gallinaceous) birds close the eye by means of the lower lid, and all birds blink by means of a skin extending over the eye from the inner corner; the owl and its congeners also close the eye by means of the upper lid. The same phenomenon is observable in the animals that are protected by horny shields, as in the lizard and its congeners; for they all without exception close the eye with the lower lid, but they do not blink like birds. Further, birds have neither shields nor hair, but feathers; and the feathers are invariably furnished with quills. They have no tail, but a rump with tail-feathers, short in such as are long-legged and web-footed, large in others. These latter kinds of birds fly with their feet tucked up close to the belly; but the small rump or short-tailed birds fly with their legs stretched out at full length.

All are furnished with a tongue, but the organ is variable, being long in some birds and broad in others. Certain species of birds above all other animals, and next after man, possess the faculty of uttering articulate sounds; and this faculty is chiefly developed in broad-tongued birds. No oviparous creature has an epiglottis over the windpipe, but these animals so manage the opening and shutting of the windpipe as not to allow any solid substance to get down into the lung.

Some species of birds are furnished additionally with spurs, but no bird with crooked talons is found so provided. The birds with talons are among those that fly well, but those that have spurs are among the heavy-bodied.

Again, some birds have a crest. As a general rule the crest sticks up, and is composed of feathers only; but the crest of the barn-door cock is exceptional in kind, for, whereas it is not just exactly flesh, at the same time it is not easy to say what else it is.

13

Of water animals the genus of fishes constitutes a single group apart from the rest, and including many diverse forms.

In the first place, the fish has a head, a back, a belly, in the neighbourhood of which last are placed the stomach and viscera; and behind it has a tail of continuous, undivided shape, but not, by the way, in all cases alike. No fish has a neck, or any limb, or testicles at all, within or without, or breasts. But, by the way this absence of breasts may predicated of all non-viviparous animals; and in point of fact viviparous animals are not in all cases provided with the organ, excepting such as are directly viviparous without

being first oviparous. Thus, the dolphin is directly viviparous, and accordingly we find it furnished with two breasts, not situated high up, but in the neighbourhood of the genitals. And this creature is not provided, like quadrupeds, with visible teats, but has two vents, one on each flank, from which the milk flows; and its young have to follow after it to get suckled, and this phenomenon has been actually witnessed.

Fishes, then, as has been observed, have no breasts and no passage for the genitals visible externally. But they have an exceptional organ in the gills, whereby, after taking the water in the mouth, they discharge it again; and in the fins, of which the greater part has four, and the lanky ones two, as, for instance, the eel, and these two situated near to the gills. In like manner the grey mullet-as, for instance, the mullet found in the lake at siphons -have only two fins; and the same is the case with the fish called Ribbon-fish. Some of the lanky fishes have no fins at all, such as the moray eel, nor gills articulated like those of other fish.

And of those fish that are provided with gills, some have coverings for this organ, whereas all the selachians have the organ unprotected by a cover. And those fishes that have coverings or opercula for the gills have in all cases their gills placed sideways; whereas, among selachians, the broad ones have the gills down below on the belly, as the torpedo and the ray, while the lanky ones have the organ placed sideways, as is the case in all the dog-fish.

The fishing-frog has gills placed sideways, and covered not with a spiny operculum, as in all but the selachian fishes, but with one of skin.

Moreover, with fishes furnished with gills, the gills in some cases are simple in others duplicate; and the last gill in the direction of the body is always simple. And, again, some fishes have few gills, and others have a great number; but all alike have the same number on both sides. Those that have the least number have one gill on either side, and this one duplicate, like the boar-fish; others have two on either side, one simple and the other duplicate, like the conger and the shield; others have four on either side, simple, as the elope, the synergies, the moray eel, and the eel; others have four, all, with the exception of the hindmost one, in double rows, as the wrasse, the perch, the sheat-fish, and the carp. The dog-fish have all their gills double, five on a side; and the sword-fish has eight double gills. So much for the number of gills as found in fishes.

Again, fishes differ from other animals in more ways than as regards the gills. For they are not covered with hairs as are viviparous land animals, nor, as is the case with certain oviparous quadrupeds, with tessellated shield, nor, like birds, with feathers; but for the most part they are covered with scales. Some few are rough-skinned, while the smooth-skinned are very few indeed. Of the Selachia some are rough-skinned and some smooth-skinned; and among the smooth-skinned fishes are included the conger, the eel, and the tunny.

All fishes are saw-toothed excepting the scarus; and the teeth in all cases are sharp and set in many rows, and in some cases are placed on the tongue. The tongue is hard and

spiny, and so firmly attached those fishes in many instances seem to be devoid of the organ altogether. The mouth in some cases is wide-stretched, as it is with some viviparous quadrupeds.

With regard to organs of sense, all save eyes, fishes possess none of them, neither the organs nor their passages, neither ears nor nostrils; but all fishes are furnished with eyes, and the eyes devoid of lids, though the eyes are not hard; with regard to the organs connected with the other senses, hearing and smell, they are devoid alike of the organs themselves and of passages indicative of them.

Fishes without exception are supplied with blood. Some of them are oviparous, and some viviparous; scaly fish are invariably oviparous, but cartilaginous fishes are all viviparous, with the single exception of the fishing-frog.

14

Of blooded animals there now remains the serpent genus. This genus is common to both elements, for, while most species comprehended therein are land animals, a small minority, to wit the aquatic species, pass their lives in fresh water. There are also sea-serpents, in shape to a great extent resembling their congeners of the land, with this exception that the head in their case is somewhat like the head of the conger; and there are several kinds of sea-serpent, and the different kinds differ in colour; these animals are not found in very deep water. Serpents, like fish, are devoid of feet.

There are also sea-scolopendras, resembling in shape their land congeners, but somewhat less in regard to magnitude. These creatures are found in the neighbourhood of rocks; as compared with their land congeners they are redder in colour, are furnished with feet in greater numbers and with legs of more delicate structure. And the same remark applies to them as to the sea-serpents, that they are not found in very deep water.

Of fishes whose habitat is in the vicinity of rocks there is a tiny one, which some call the Achenes, or 'ship-holder', and which is by some people used as a charm to bring luck in affairs of law and love. The creature is unfit for eating. Some people assert that it has feet, but this is not the case: it appears, however, to be furnished with feet from the fact that its fins resemble those organs.

So much, then, for the external parts of blooded animals, as regards their numbers, their properties, and their relative diversities.

15

As for the properties of the internal organs, these we must first discuss in the case of the animals that are supplied with blood. For the principal genera differ from the rest of animals, in that the former are supplied with blood and the latter are not; and the former include man, viviparous and oviparous quadrupeds, birds, fishes, cetaceans, and all the others that come under no general designation by reason of their not forming genera,

but groups of which simply the specific name is predicable, as when we say 'the serpent, the 'crocodile'.

All viviparous quadrupeds, then, are furnished with an oesophagus and a windpipe, situated as in man; the same statement is applicable to oviparous quadrupeds and to birds, only that the latter present diversities in the shapes of these organs. As a general rule, all animals that take up air and breathe it in and out are furnished with a lung, a windpipe, and an oesophagus, with the windpipe and oesophagus not admitting of diversity in situation but admitting of diversity in properties, and with the lung admitting of diversity in both these respects. Further, all blooded animals have a heart and a diaphragm or midriff; but in small animals the existence of the latter organ is not so obvious owing to its delicacy and minute size.

In regard to the heart there is an exceptional phenomenon observable in Oxen. In other words, there is one species of ox where though not in all cases, a bone is found inside the heart. And, by the way, the horse's heart also has a bone inside it.

The genera referred to above are not in all cases furnished with a lung: for instance, the fish is devoid of the organ, as is also every animal furnished with gills. All blooded animals are furnished with a liver. As a general rule blooded animals are furnished with a spleen; but with the great majority of non-viviparous but oviparous animals the spleen is so small as all but to escape observation; and this is the case with almost all birds, as with the pigeon, the kite, the falcon, the owl: in point of fact, the aegocephalus is devoid of the organ altogether. With oviparous quadrupeds the case is much the same as with the viviparous; that is to say, they also have the spleen exceedingly minute, as the tortoise, the freshwater tortoise, the toad, the lizard, the crocodile, and the frog.

Some animals have a gall-bladder close to the liver, and others have not. Of viviparous quadrupeds the deer is without the organ, as also the roe, the horse, the mule, the ass, the seal, and some kinds of pigs. Of deer those that are called Achaian appear to have gall in their tail, but what is so called does resemble gall in colour, though it is not so completely fluid, and the organ internally resembles a spleen.

However, without any exception, stags are found to have maggots living inside the head, and the habitat of these creatures is in the hollow underneath the root of the tongue and in the neighbourhood of the vertebra to which the head is attached. These creatures are as large as the largest grubs; they grow all together in a cluster, and they are usually about twenty in number.

Deer then, as has been observed, are without a gall-bladder; their gut, however, is so bitter that even hounds refuse to eat it unless the animal is exceptionally fat. With the elephant also the liver is unfurnished with a gall bladder, but when the animal is cut in the region where the organ is found in animals furnished with it, there oozes out a fluid resembling gall, in greater or less quantities. Of animals that take in sea-water and are furnished with a lung, the dolphin is unprovided with a gall-bladder. Birds and fishes all have the organ, as also oviparous quadrupeds, all to a greater or a lesser extent.

But of fishes some have the organ close to the liver, as the dogfishes, the sheat-fish, the rhine or angel-fish, the smooth skate, the torpedo, and, of the lanky fishes, the eel, the pipe-fish, and the hammer-headed shark. The callonymus, also, has the gall-bladder close to the liver, and in no other fish does the organ attain so great a relative size. Other fishes have the organ close to the gut, attached to the liver by certain extremely fine ducts. The bonito has the gall-bladder stretched alongside the gut and equalling it in length, and often a double fold of it. others have the organ in the region of the gut; in some cases, far off, in others near; as the fishing-frog, the elope, the synergies, the moray eel, and the sword-fish. Often animals of the same species show this diversity of position; as, for instance, some congers are found with the organ attached close to the liver, and others with it detached from and below it. The case is much the same with birds: that is, some have the gall-bladder close to the stomach, and others close to the gut, as the pigeon, the raven, the quail, the swallow, and the sparrow; some have it near at once to the liver and to the stomach as the aegocephalus; others have it near at once to the liver and the gut, as the falcon and the kite.

16

Again, all viviparous quadrupeds are furnished with kidneys and a bladder. Of the ovipara that are not quadrupedal there is no instance known of an animal, whether fish or bird, provided with these organs. of the ovipara that are quadrupedal, the turtle alone is provided with these organs of a magnitude to correspond with the other organs of the animal. In the turtle the kidney resembles the same organ in the ox; that is to say, it looks one single organ composed of a number of small ones. (The bison also resembles the ox in all its internal parts).

17

With all animals that are furnished with these parts, the parts are similarly situated, and with the exception of man, the heart is in the middle; in man, however, as has been observed, the heart is placed a little to the left-hand side. In all animals the pointed end of the heart turns frontwards; only in fish
it would at first sight seem otherwise, for the pointed end is turned not towards the breast, but towards the head and the mouth. And (in fish) the apex is attached to a tube just where the right and left gills meet together. There are other ducts extending from the heart to each of the gills, greater in the greater fish, lesser in the lesser; but in the large fishes the duct at the pointed end of the heart is a tube, white-coloured and exceedingly thick. Fishes in some few cases have an oesophagus, as the conger and the eel; and in these the organ is small.

In fishes that are furnished with an undivided liver, the organ lies entirely on the right side; where the liver is cloven from the root, the larger half of the organ is on the right side: for in some fishes the two parts are detached from one another, without any coalescence at the root, as is the case with the dogfish. And there is also a species of

hare in what is named the Fig district, near Lake Bolbe, and elsewhere, which animal might be taken to have two livers owing to the length of the connecting ducts, similar to the structure in the lung of birds.

The spleen in all cases, when normally placed, is on the left-hand side, and the kidneys also lie in the same position in all creatures that possess them. There have been known instances of quadrupeds under dissection, where the spleen was on the right hand and the liver on the left; but all such cases are regarded as supernatural.

In all animals the wind-pipe extends to the lung, and the manner how, we shall discuss hereafter; and the oesophagus, in all that have the organ, extends through the midriff into the stomach. For, by the way, as has been observed, most fishes have no oesophagus, but the stomach is united directly with the mouth, so that in some cases when big fish are pursuing little ones, the stomach tumbles forward into the mouth.

All the afore-mentioned animals have a stomach, and one similarly situated, that is to say, situated directly under the midriff; and they have a gut connected therewith and closing at the outlet of the residuum and at what is termed the 'rectum'. However, animals present diversities in the structure of their stomachs. In the first place, of the viviparous quadrupeds, such of the horned animals as are not equally furnished with teeth in both jaws are furnished with four such chambers. These animals, by the way, are those that are said to chew the cud. In these animals the oesophagus extends from the mouth downwards along the lung, from the midriff to the big stomach (or paunch); and this stomach is rough inside and semi-partitioned. And connected with it near to the entry of the oesophagus is what from its appearance is termed the 'reticulum' (or honeycomb bag); for outside it is like the stomach, but inside it resembles a netted cap; and the reticulum is a great deal smaller than the stomach. Connected with this is the 'echinus' (or many-plies), rough inside and laminated, and of about the same size as the reticulum. Next after this comes what is called the 'enystrum' (or abomasum), larger a longer than the echinus, furnished inside with numerous folds or ridges, large and smooth. After all this comes the gut.

Such is the stomach of those quadrupeds that are horned and have an unsymmetrical dentition; and these animals differ one from another in the shape and size of the parts, and in the fact of the oesophagus reaching the stomach centralise in some cases and sideways in others. Animals that are furnished equally with teeth in both jaws have one stomach; as man, the pig, the dog, the bear, the lion, the wolf. (The Thos, by the by, has all its internal organs similar to the wolf's.)

All these, then have a single stomach, and after that the gut; but the stomach in some is comparatively large, as in the pig and bear, and the stomach of the pig has a few smooth folds or ridges; others have a much smaller stomach, not much bigger than the gut, as the lion, the dog, and man. In the other animals the shape of the stomach varies in the direction of one or other of those already mentioned; that is, the stomach in some animals resembles that of the pig; in others that of the dog, alike with the larger animals and the smaller ones. In all these animals’ diversities occur in regard to the size, the

shape, the thickness or the thinness of the stomach, and also in regard to the place where the oesophagus opens into it.

There is also a difference in structure in the gut of the two groups of animals above mentioned (those with unsymmetrical and those with symmetrical dentition) in size, in thickness, and in folding.

The intestines in those animals whose jaws are unequally furnished with teeth are in all cases the larger, for the animals themselves are larger than those in the other category; for very few of them are small, and no single one of the horned animals is very small. And some possess appendages (or caeca) to the gut, but no animal that has not incisors in both jaws has a straight gut.

The elephant has a gut constricted into chambers, so constructed that the animal appears to have four stomachs; in it the food is found, but there is no distinct and separate receptacle. Its viscera resemble those of the pig, only that the liver is four times the size of that of the ox, and the other viscera in like proportion, while the spleen is comparatively small.

Much the same may be predicated of the properties of the stomach and the gut in oviparous quadrupeds, as in the land tortoise, the turtle, the lizard, both crocodiles, and, in fact, in all animals of the like kind; that is to say, their stomach is one and simple, resembling in some cases that of the pig, and in other cases that of the dog.

The serpent genus is similar and in almost all respects furnished similarly to the saurian among land animals, if one could only imagine these saurian to be increased in length and to be devoid of legs. That is to say, the serpent is coated with tessellated shields, and resembles the saurian in its back and belly; only, by the way, it has no testicles, but, like fishes, has two ducts converging into one, and an ovary long and bifurcate. The rest of its internal organs are identical with those of the saurian, except that, owing to the narrowness and length of the animal, the viscera are correspondingly narrow and elongated, so that they are apt to escape recognition from the similarities in shape. Thus, the windpipe of the creature is exceptionally long, and the oesophagus is longer still, and the windpipe commences so close to the mouth that the tongue appears to be underneath it; and the windpipe seems to project over the tongue, owing to the fact that the tongue draws back into a sheath and does not remain in its place as in other animals. The tongue, moreover, is thin and long and black, and can be protruded to a great distance. And both serpents and saurian have this altogether exceptional property in the tongue, that it is forked at the outer extremity, and this property is the more marked in the serpent, for the tips of his tongue are as thin as hairs. The seal, also, by the way, has a split tongue.

The stomach of the serpent is like a more spacious gut, resembling the stomach of the dog; then comes the gut, long, narrow, and single to the end. The heart is situated close to the pharynx, small and kidney-shaped; and for this reason, the organ might in some cases appear not to have the pointed end turned towards the breast. Then comes the

lung, single, and articulated with a membranous passage, very long, and quite detached from the heart. The liver is long and simple; the spleen is short and round: as is the case in both respects with the saurian. Its gall resembles that of the fish; the water-snakes have it beside the liver, and the other snakes have it usually beside the gut. These creatures are all saw-toothed. Their ribs are as numerous as the days of the month; in other words, they are thirty in number.

Some affirm that the same phenomenon is observable with serpents as with swallow chicks; in other words, they say that if you pick out a serpent's eyes they will grow again. And further, the tails of saurian and of serpents, if they be cut off, will grow again.

With fishes the properties of the gut and stomach are similar; that is, they have a stomach single and simple, but variable in shape according to species. For in some cases the stomach is gut-shaped, as with the scarus, or parrot-fish; which fish, by the way, appears to be the only fish that chews the cud. And the whole length of the gut is simple, and if it has a reduplication or kink it loosens out again into a simple form.

An exceptional property in fishes and in birds for the most part is the being furnished with gut-appendages or caeca. Birds have them low down and few in number. Fishes have them high up about the stomach, and sometimes numerous, as in the goby, the helmets, the perch, the Scorpaena, the citharas, the red mullet, and the Sparus; the chestnut or grey mullet has several of them on one side of the belly, and on the other side only one.

Some fish possess these appendages but only in small numbers, as the hepatis and the glaucus; and, by the way, they are few also in the dorado. These fishes differ also from one another within the same species, for in the dorado one individual has many and another few. Some fishes are entirely without the part, as the majority of the selachians. As for all the rest, some of them have a few and some a great many. And in all cases where the gut- appendages are found in fish, they are found close up to the stomach.

In regard to their internal parts birds differ from other animals and from one another. Some birds, for instance, have a crop in front of the stomach, as the barn-door cock, the cushat, the pigeon, and the partridge; and the crop consists of a large hollow skin, into which the food first enters and where it lies ingested. Just where the crop leaves the oesophagus it is somewhat narrow; by and by it broadens out, but where it communicates with the stomach it narrows down again. The stomach (or gizzard) in most birds is fleshy and hard, and inside is a strong skin which comes away from the fleshy part. Other birds have no crop, but instead of it an oesophagus wide and roomy, either all the way or in the part leading to the stomach, as with the daw, the raven, and the carrion-crow. The quail also has the oesophagus widened out at the lower extremity, and in the aegocephalus and the owl the organ is slightly broader at the bottom than at the top. The duck, the goose, the gull, the cataracts, and the great bustard have the oesophagus wide and roomy from one end to the other, and the same applies to a great many other birds. In some birds there is a portion of the stomach that resembles a crop, as in the kestrel. In the case of small birds like the swallow and the sparrow neither the

oesophagus nor the crop is wide, but the stomach is long. Some few have neither a crop nor a dilated oesophagus, but the latter is exceedingly long, as in long necked birds, such as the porphyry, and, by the way, in the case of all these birds the excrement is unusually moist. The quail is exceptional in regard to these organs, as compared with other birds; in other words, it has a crop, and at the same time its oesophagus is wide and spacious in front of the stomach, and the crop is at some distance, relatively to its size, from the oesophagus at that part.

Further, in most birds, the gut is thin, and simple when loosened out. The gut-appendages or caeca in birds, as has been observed, are few in number, and are not situated high up, as in fishes, but low down towards the extremity of the gut. Birds, then, have caeca-not all, but the greater part of them, such as the barn-door cock, the partridge, the duck, the night-raven, (the local,) the ascalaphus, the goose, the swan, the great bustard, and the owl. Some of the little birds also have these appendages; but the caeca in their case are exceedingly minute, as in the sparrow.

Book 3

1

Now that we have stated the magnitudes, the properties, and the relative differences of the other internal organs, it remains for us to treat of the organs that contribute to generation. These organs in the female are in all cases internal; in the male they present numerous diversities.

In the blooded animals some males are altogether devoid of testicles, and some have the organ but situated internally; and of those males that have the organ internally situated, some have it close to the loin in the neighbourhood of the kidney and others close to the belly. Other males have the organ situated externally. In the case of these last, the penis is in some cases attached to the belly, whilst in others it is loosely suspended, as is the case also with the testicles; and, in the cases where the penis is attached to the belly, the attachment varies accordingly as the animal is emprosthuretic or opisthuretic (emotional or drugged).

No fish is furnished with testicles, nor any other creature that has gills, nor any serpent whatever: nor, in short, any animal devoid of feet, save such only as are viviparous within themselves. Birds are furnished with testicles, but these are internally situated, close to the loin. The case is similar with oviparous quadrupeds, such as the lizard, the tortoise and the crocodile; and among the viviparous animals this peculiarity is found in the hedgehog. Others among those creatures that have the organ internally situated have it close to the bely, as is the case with the dolphin amongst animals devoid of feet, and with the elephant among viviparous quadrupeds. In other cases, these organs are externally conspicuous.

We have already alluded to the diversities observed in the attachment of these organs to the belly and the adjacent region; in other words, we have stated that in some cases the testicles are tightly fastened back, as in the pig and its allies, and that in others they are freely suspended, as in man.

Fishes, then, are devoid of testicles, as has been stated, and serpents also.

They are furnished, however, with two ducts connected with the midriff and running on to either side of the backbone, coalescing into a single duct above the outlet of the residuum, and by 'above' the outlet I mean the region near to the spine. These ducts in the rutting season get filled with the genital fluid, and, if the ducts be squeezed, the sperm o0zes out white in colour. As to the differences observed in male fishes of diverse species, the reader should consult my treatise on Anatomy, and the subject will be hereafter more fully discussed when we describe the specific character in each case.

The males of oviparous animals, whether biped or quadruped, are in all cases furnished with testicles close to the loin underneath the midriff. With some animals the organ is whitish, in others somewhat of a sallow hue; in all cases it is entirely enveloped with

minute and delicate veins. From each of the two testicles extends a duct, and, as in the case of fishes, the two ducts coalesce into one above the outlet of the residuum. This constitutes the penis, which organ in the case of small ovipara is inconspicuous; but in the case of the larger ovipara, as in the goose and the like, the organ becomes quite visible just after copulation.

The ducts in the case of fishes and in biped and quadruped ovipara are attached to the loin under the stomach and the gut, in betwixt them and the great vein, from which ducts or blood-vessels extend, one to each of the two testicles. And just as with fishes the male sperm is found in the seminal ducts, and the ducts become plainly visible at the rutting season and in some instances become invisible after the season is passed, so also is it with the testicles of birds; before the breeding season the organ is small in some birds and quite invisible in others, but during the season the organ in all cases is greatly enlarged. This phenomenon is remarkably illustrated in the ring-dove and the partridge, so much so that some people are actually of opinion that these birds are devoid of the organ in the winter-time.

Of male animals that have their testicles placed frontwards, some have them inside, close to the belly, as the dolphin; some have them outside, exposed to view, close to the lower extremity of the belly. These animals resemble one another thus far in respect to this organ; but they differ from one another in this fact, that some of them have their testicles situated separately by themselves, while others, which have the organ situated externally, have them enveloped in what is termed the scrotum.

Again, in all viviparous animals furnished with feet the following properties are observed in the testicles themselves. From the aorta there extend vein- like ducts to the head of each of the testicles, and another two from the kidneys; these two from the kidneys are supplied with blood, while the two from the aorta are devoid of it. From the head of the testicle alongside of the testicle itself is a duct, thicker and sinewier than the other just alluded to-a duct that bends back again at the end of the testicle to its head; and from the head of each of the two testicles the two ducts extend until they coalesce in front at the penis. The duct that bends back again and that which is in contact with the testicle are enveloped in one and the same membrane, so that, until you draw aside the membrane, they present all the appearance of being a single undifferentiated duct. Further, the duct in contact with the testicle has its moist content qualified by blood, but to a comparatively less extent than in the case of the ducts higher up which are connected with the aorta; in the ducts that bend back towards the tube of the penis, the liquid is white-coloured. There also runs a duct from the bladder, opening into the upper part of the canal, around which lies, sheath wise, what is called the 'penis'.

All these descriptive particulars may be regarded by the light of the accompanying diagram; wherein the letter A marks the starting-point of the ducts that extend from the aorta; the letters KK mark the heads of the testicles and the ducts descending thereunto; the ducts extending from these along the testicles are marked MM; the ducts turning back, in which is the white fluid, are marked BB; the penis D; the bladder E; and the testicles XX.

(By the way, when the testicles are cut off or removed, the ducts draw upwards by contraction. Moreover, when male animals are young, their owner sometimes destroys the organ in them by attrition; sometimes they castrate them at a later period. And I may here add, that a bull has been known to serve a cow immediately after castration, and actually to impregnate her.)

So much then for the properties of testicles in male animals.

In female animals furnished with a womb, the womb is not in all cases the same in form or endowed with the same properties, but both in the vivipara and the ovipara great diversities present themselves. In all creatures that have the womb close to the genitals, the womb is two-horned, and one horn lies to the right-hand side and the other to the left; its commencement, however, is single, and so is the orifice, resembling in the case of the most numerous and largest animals a tube composed of much flesh and gristle.

Of these parts one is termed the hysteria or delphs, whence is derived the word Adolphos, and the other part, the tube or orifice, is termed metra. In all biped or quadruped vivipara, the womb is in all cases below the midriff, as in man, the dog, the pig, the horse, and the ox; the same is the case also in all horned animals. At the extremity of the so-called wax, or horns, the wombs of most animals have a twist or convolution.

In the case of those ovipara that lay eggs externally, the wombs are not in all cases similarly situated. Thus the wombs of birds are close to the midriff, and the wombs of fishes down below, just like the wombs of biped and quadruped vivipara, only that, in the case of the fish, the wombs are delicately formed, membranous, and elongated; so much so that in extremely small fish, each of the two bifurcated parts looks like a single egg, and those fishes whose egg is described as crumbling would appear to have inside them a pair of eggs, whereas in reality each of the two sides consists not of one but of many eggs, and this accounts for their breaking up into so many particles.

The womb of birds has the lower and tubular portion fleshy and firm, and the part close to the midriff membranous and exceedingly thin and fine: so thin and fine that the eggs might seem to be outside the womb altogether. In the larger birds the membrane is more distinctly visible, and, if inflated through the tube, lifts and swells out; in the smaller birds all these parts are more indistinct.

The properties of the womb are similar in oviparous quadrupeds, as the tortoise, the lizard, the frog and the like; for the tube below is single and fleshy, and the cleft portion with the eggs is at the top close to the midriff.

With animals devoid of feet that are internally oviparous and viviparous externally, as is the case with the dogfish and the other so-called Selachians (and by this title we designate such creatures destitute of feet and furnished with gills as are viviparous),

with these animals the womb is bifurcate, and beginning down below it extends as far as the midriff, as in the case of birds.

There is also a narrow part between the two horns running up as far as the midriff, and the eggs are engendered here and above at the origin of the midriff; afterwards they pass into the wider space and turn from eggs into young animals. However, the differences in respect to the wombs of these fishes as compared with others of their own species or with fishes in general, would be more satisfactorily studied in their various forms in specimens under dissection.

The members of the serpent genus also present divergencies either when compared with the above-mentioned creatures or with one another.

Serpents as a rule are oviparous, the viper being the only viviparous member of the genus. The viper is, previously to external parturition, oviparous internally; and owing to this peculiarity the properties of the womb in the viper are similar to those of the womb in the selachians. The womb of the serpent is long, in keeping with the body, and starting below from a single duct extends continuously on both sides of the spine, so as to give the impression of this being a separate duct on each side of the spine, until it reaches the midriff, where the eggs are engendered in a row; and these eggs are laid not one by one, but all strung together. (And all animals that are viviparous both internally and externally have the womb situated above the stomach, and all the ovipara underneath, near to the loin. Animals that are viviparous externally and internally oviparous present an intermediate arrangement; for the underneath portion of the womb, in which the eggs are, is placed near to the loin, but the part about the orifice is above the gut.)

Further, there is the following diversity observable in wombs as compared with one another: namely that the females of horned non-Ambiental animals are furnished with cotyledons in the womb when they are pregnant, and such is the case, among Ambientals, with the hare, the mouse, and the bat; whereas all other animals that are Ambiental, viviparous, and furnished with feet, have the womb quite smooth, and in their case the attachment of the embryo is to the womb itself and not to any cotyledon inside it.

The parts, then, in animals that are not homogeneous with themselves and uniform in their texture, both parts external and parts internal, have the properties above assigned to them.

2

In sanguineous animals the homogeneous or uniform part most universally found is the blood, and its habitat the vein; next in degree of universality, their analogues, lymph and fibre, and, that which chiefly constitutes the frame of animals, flesh and whatsoever in the several parts is analogous to flesh; then bone, and parts that are analogous to bone, as fish-bone and gristle; and then, again, skin, membrane, sinew,

hair, nails, and whatever corresponds to these; and, furthermore, fat, suet, and the excretions: and the excretions are dung, phlegm, yellow bile, and black bile.

Now, as the nature of blood and the nature of the veins have all the appearance of being primitive, we must discuss their properties first of all,
and all the more as some previous writers have treated them very unsatisfactorily. And the cause of the ignorance thus manifested is the extreme difficulty experienced in the way of observation. For in the dead bodies of animals the nature of the chief veins is undiscoverable, owing to the fact that they collapse at once when the blood leaves them; for the blood pours out of them in a stream, like liquid out of a vessel, since there is no blood separately situated by itself, except a little in the heart, but it is all lodged in the veins. In living animals, it is impossible to inspect these parts, for of their very nature they are situated inside the body and out of sight.

For this reason, anatomists who have carried on their investigations on dead bodies in the dissecting room have failed to discover the chief roots of the veins, while those who have narrowly inspected bodies of living men reduced to extreme attenuation have arrived at conclusions regarding the origin of the veins from the manifestations visible externally. Of these investigators, Synesis, the physician of Cyprus, writes as follows:

The big veins run thus: -from the navel across the loins, along the back, past the lung, in under the breasts; one from right to left, and the other from left to right; that from the left, through the liver to the kidney and the testicle, that from the right, to the spleen and kidney and testicle, and from thence to the penis.' Diogenes of Apollonia writes thus:

The veins in man are as follows: -There are two veins pre-eminent in magnitude. These extend through the belly along the backbone, one to right, one to left; either one to the leg on its own side, and upwards to the head, past the collar bones, through the throat. From these, veins extend all over the body, from that on the right hand to the right side and from that on the left hand to the left side; the most important ones, two in number, to the heart in the region of the backbone; other two a little higher up through the chest in underneath the armpit, each to the hand on its side: of these two, one being termed the vein splenitis, and the other the vein hepatitis.

Each of the pair splits at its extremity; the one branches in the direction of the thumb and the other in the direction of the palm; and from these runs off a number of minute veins branching off to the fingers and to all parts of the hand. Other veins, more minute, extend from the main veins; from that on the right towards the liver, from that on the left towards the spleen and the kidneys. The veins that run to the legs split at the juncture of the legs with the trunk and extend right down the thigh. The largest of these goes down the thigh at the back of it, and can be discerned and traced as a big one; the second one runs inside the thigh, not quite as big as the one just mentioned.

After this they pass on along the knee to the shin and the foot (as the upper veins were described as passing towards the hands), and arrive at the sole of the foot, and from

thence continue to the toes. Moreover, many delicate veins separate off from the great veins towards the stomach and towards the ribs.

The veins that run through the throat to the head can be discerned and traced in the neck as large ones; and from each one of the two, where it terminates, there branch off a number of veins to the head; some from the right side towards the left, and some from the left side towards the right; and the two veins terminate near to each of the two ears. There is another pair of veins in the neck running along the big vein on either side, slightly less in size than the pair just spoken of, and with these the greater part of the veins in the head are connected.

This other pair runs through the throat inside; and from either one of the two there extend veins in underneath the shoulder blade and towards the hands; and these appear alongside the veins splenitis and hepatitis as another pair of veins smaller in size. When there is a pain near the surface of the body, the physician lances these two latter veins; but when the pain is within and in the region of the stomach, he lances the veins splenitis and hepatitis. And from these, other veins depart to run below the breasts.

There is also another pair running on each side through the spinal marrow to the testicles, thin and delicate. There is, further, a pair running a little underneath the cuticle through the flesh to the kidneys, and these with men terminate at the testicle, and with women at the womb. These veins are termed the spermatic veins. The veins that leave the stomach are comparatively broad just as they leave; but they become gradually thinner, until they change over from right to left and from left to right.

'Blood is thickest when it is imbibed by the fleshy parts; when it is transmitted to the organs above-mentioned, it becomes thin, warm, and frothy.'

3

Such are the accounts given by Synesis and Diogenes. Polybus writes to the following effect: -

There are four pairs of veins. The first extends from the back of the head, through the neck on the outside, past the backbone on either side, until it reaches the loins and passes on to the legs, after which it goes on through the shins to the outer side of the ankles and on to the feet. And it is on this account that surgeons, for pains in the back and loin, bleed in the ham and in the outer side of the ankle. Another pair of veins runs from the head, past ears, through the neck; which veins are termed the jugular veins. This pair goes on inside along the backbone, past the muscles of the loins, on to the testicles, and onwards to the thighs, and through the inside of the hams and through the shins down to the inside of the ankles and to the feet; and for this reason, surgeons, for pains in the muscles of the loins and in the testicles, bleed on the hams and the inner side of the ankles. The third pair extends from the temples, through the neck, in underneath the shoulder-blades, into the lung; those from right to left going in underneath the breast and on to the spleen and the kidney; those from left to right running from the lung in

underneath the breast and into the liver and the kidney; and both terminate in the fundament. The fourth pair extend from the front part of the head and the eyes in underneath the neck and the collar-bones; from thence they stretch on through the upper part of the upper arms to the elbows and then through the fore-arms on to the wrists and the jointing's of the fingers, and also through the lower part of the upper-arms to the armpits, and so on, keeping above the ribs, until one of the pair reaches the spleen and the other reaches the liver; and after this they both pass over the stomach and terminate at the penis.'

The above quotations sum up pretty well the statements of all previous writers. Furthermore, there are some writers on Natural History who have not ventured to lay down the law in such precise terms as regards the veins, but who all alike agree in assigning the head and the brain as the starting-point of the veins. And in this opinion, they are mistaken.

The investigation of such a subject, as has been remarked, is one fraught with difficulties; but, if anyone be keenly interested in the matter, his best plan will be to allow his animals to starve to emaciation, then to strangle them on a sudden, and thereupon to prosecute his investigations.

We now proceed to give particulars regarding the properties and functions of the veins. There are two blood-vessels in the thorax by the backbone, and lying to its inner side; and of these two the larger one is situated to the front, and the lesser one is to the rear of it; and the larger is situated rather than the right hand side of the body, and the lesser one to the left; and by some this vein is termed the 'aorta', from the fact that even in dead bodies part of it is observed to be full of air. These blood-vessels have their origins in the heart, for they traverse the other viscera, in whatever direction they happen to run, without in any way losing their distinctive characteristic as blood-vessels, whereas the heart is as it were a part of them (and that to more in respect to the frontward and larger one of the two), owing to the fact that these two veins are above and below, with the heart lying midway.

The heart in all animals has cavities inside it. In the case of the smaller animals even the largest of the chambers is scarcely discernible; the second larger is scarcely discernible in animals of medium size; but in the largest animals all three chambers are distinctly seen.

In the heart then (with its pointed end directed frontwards, as has been observed) the largest of the three chambers is on the right-hand side and highest up; the least one is on the left-hand side; and the medium-sized one lies in betwixt the other two; and the largest one of the three chambers is a great deal larger than either of the two others. All three, however, are connected with passages leading in the direction of the lung, but all these communications are indistinctly discernible by reason of their minuteness, except one.

The great blood-vessel, then, is attached to the biggest of the three chambers, the one that lies uppermost and on the right-hand side; it then extends right through the chamber, coming out as blood-vessel again; just as though the cavity of the heart were a part of the vessel, in which the blood broadens its channel as a river that widens out in a lake. The aorta is attached to the middle chamber; only, by the way, it is connected with it by much narrower pipe.

The great blood-vessel then passes through the heart (and runs from the heart into the aorta). The great vessel looks as though made of membrane or skin, while the aorta is narrower than it, and is very sinewy; and as it stretches away to the head and to the lower parts it becomes exceedingly narrow and sinewy.

First of all, then, upwards from the heart there stretches a part of the great blood-vessel towards the lung and the attachment of the aorta, a part consisting of a large undivided vessel. But there split off from it two parts; one towards the lung and the other towards the backbone and the last vertebra of the neck.

The vessel, then, that extends to the lung, as the lung itself is duplicate, divides at first into two; and then extends along by every pipe and every perforation, greater along the greater ones, lesser along the less, so continuously that it is impossible to discern a single part wherein there is not perforation and vein; for the extremities are indistinguishable from their minuteness, and in point of fact the whole lung appears to be filled with blood.

The branches of the blood-vessels lie above the tubes that extend from the windpipe. And that vessel which extends to the vertebra of the neck and the backbone, stretches back again along the backbone; as Homer represents in the lines: -

- (Antilochus, as Thoon turned him round),
- Transpired his back with a dishonest wound;
- The hollow vein that to the neck extends,
- Along the chine, the eager javelin rends.

From this vessel there extend small blood-vessels at each rib and each vertebra; and at the vertebra above the kidneys the vessel bifurcates. And in the above way the parts branch off from the great blood-vessel.

But up above all these, from that part which is connected with the heart, the entire vein branches off in two directions. For its branches extend to the sides and to the collarbones, and then pass on, in men through the armpits to the arms, in quadrupeds to the forelegs, in birds to the wings, and in fishes to the upper or pectoral fins. (See diagram.)
The trunks of these veins, where they first branch off, are called the 'jugular' veins; and, where they branch off to the neck the great vein run alongside the windpipe; and, Occasionally, if these veins are pressed externally, men, though not actually choked, become insensible, shut their eyes, and fall flat on the ground.

Extending in the way described and keeping the windpipe in betwixt them, they pass on until they reach the ears at the junction of the lower jaw with the skull. Hence again they branch off into four veins, of which one bends back and descends through the neck and the shoulder, and meets the previous branching off of the vein at the bend of the arm, while the rest of it terminates at the hand and fingers. (See diagram.).

Each vein of the other pair stretches from the region of the ear to the brain, and branches off in a number of fine and delicate veins into the so-called meninx, or membrane, which surrounds the brain. The brain itself in all animals are destitute of blood, and no vein, great or small, holds its course therein.

But of the remaining veins that branch off from the last-mentioned vein some envelop the head, others close their courses in the organs of sense and at the roots of the teeth in veins exceedingly fine and minute.

4

And in like manner the parts of the lesser one of the two chief blood-vessels, designated the aorta, branch off, accompanying the branches from the big vein; only that, in regard to the aorta, the passages are less in size, and the branches very considerably less than are those of the great vein. So much for the veins as observed in the regions above the heart.

The part of the great vein that lies underneath the heart extends, freely suspended, right through the midriff, and is united both to the aorta and the backbone by slack membranous communications. From it one vein, short and wide, extends through the liver, and from it a number of minute veins branch off into the liver and disappear. From the vein that passes through the liver two branches separate off, of which one terminates in the diaphragm or so-called midriff, and the other runs up again through the armpit into the right arm and unites with the other veins at the inside of the bend of the arm; and it is in consequence of this local connexion that, when the surgeon opens this vein in the forearm, the patient is relieved of certain pains in the liver; and from the left-hand side of it there extends a short but thick vein to the spleen and the little veins branching off it disappear in that organ.
Another part branches off from the left-hand side of the great vein, and ascends, by a course similar to the course recently described, into the left arm; only that the ascending vein in the one case is the vein that traverses the liver, while in this case it is distinct from the vein that runs into the spleen.
Again, other veins branch off from the big vein; one to the omentin, and another to the pancreas, from which vein run a number of veins through the mesentery. All these veins coalesce in a single large vein, along the entire gut and stomach to the oesophagus; about these parts there is a great ramification of branch veins.

As far as the kidneys, each of the two-remaining undivided, the aorta and the big vein extend; and here they get more closely attached to the backbone, and branch off, each of the two, into a shape, and the big vein gets to the rear of the aorta. But the chief attachment of the aorta to the backbone takes place in the region of the heart; and the attachment is affected by means of minute and sinewy vessels.
The aorta, just as it draws off from the heart, is a tube of considerable volume, but, as it advances in its course, it gets narrower and sinewier. And from the aorta there extend veins to the mesentery just like the veins that extend thither from the big vein, only that the branches in the case of the aorta are considerably less in magnitude; they are, indeed, narrow and fibrillar, and they end in delicate hollow fibre-like veinlets.

There is no vessel that runs from the aorta into the liver or the spleen.

From each of the two great blood-vessels there extend branches to each of the two flanks, and both branches fasten on to the bone. Vessels also extend to the kidneys from the big vein and the aorta; only that they do not open into the cavity of the organ, but their ramifications penetrate into its substance. From the aorta run two other ducts to the bladder, firm and continuous; and there are other ducts from the hollow of the kidneys, in no way communicating with the big vein. From the centre of each of the two kidneys spring a hollow sinewy vein, running along the backbone right through the loins; by and by each of the two veins first disappears in its own flank, and soon afterwards reappears stretching in the direction of the flank.

The extremities of these attach to the bladder, and also in the male to the penis and in the female to the womb. From the big vein no vein extends to the womb, but the organ is connected with the aorta by veins numerous and closely packed.

Furthermore, from the aorta and the great vein at the points of divarication there branch off other veins. Some of these runs to the groins-large hollow veins-and then pass on down through the legs and terminate in the feet and toes.

And, again, another set run through the groins and the thighs cross- garter fashion, from right to left and from left to right, and unite in the hams with the other veins.

In the above description we have thrown light upon the course of the veins and their points of departure.

In all sanguineous animals the case stands as here set forth in regard to the points of departure and the courses of the chief veins. But the description does not hold equally good for the entire vein-system in all these animals.

For, in point of fact, the organs are not identically situated in them all; and, what is more, some animals are furnished with organs of which other animals are destitute.

At the same time, while the description so far holds good, the proof of its accuracy is not equally easy in all cases, but is easiest in the case of animals of considerable magnitude and supplied abundantly with blood. For in little animals and those scantily supplied with blood, either from natural and inherent causes or from a prevalence of fat in the body, thorough accuracy in investigation is not equally attainable; for in the latter of these creatures the passages get clogged, like water-channels choked with slush; and the others have a few minute fibres to serve instead of veins.

But in all cases the big vein is plainly discernible, even in creatures of insignificant size.

5

The sinews of animals have the following properties. For these also the point of origin is the heart; for the heart has sinews within itself in the largest of its three chambers, and the aorta is a sinew-like vein; in fact, at its extremity it is actually a sinew, for it is there no longer hollow, and is stretched like the sinews where they terminate at the jointing’s of the bones.

Be it remembered, however, that the sinews do not proceed in unbroken sequence from one point of origin, as do the blood-vessels.

For the veins have the shape of the entire body, like a sketch of a mannikin; in such a way that the whole frame seems to be filled up with little veins in attenuated subjects- for the space occupied by flesh in fat individuals is filled with little veins in thin ones- whereas the sinews are distributed about the joints and the flexures of the bones. Now, if the sinews were derived in unbroken sequence from a common point of departure, this continuity would be discernible in attenuated specimens.

In the ham, or the part of the frame brought into full play in the effort of leaping, is an important system of sinews; and another sinew, a double one, is that called 'the tendon', and others are those brought into play when a great effort of physical strength is required; that is to say, the epitonic or back-stay and the shoulder-sinews. Other sinews, devoid of specific designation, are situated in the region of the flexures of the bones; for all the bones that are attached to one another are bound together by sinews, and a great quantity of sinews are placed in the neighbourhood of all the bones. Only, by the way, in the head there is no sinew; but the head is held together by the sutures of the bones.

Sinew is fissile lengthwise, but crosswise it is not easily broken, but admits of a considerable amount of hard tension. In connexion with sinews a liquid mucus is developed, white and glutinous, and the organ, in fact, is sustained by it and appears to be substantially composed of it.

Now, vein may be submitted to the actual cautery, but sinew, when submitted to such action, shrivels up altogether; and, if sinews be cut asunder, the severed parts will not again cohere.

A feeling of numbness is incidental only to parts of the frame where sinew is situated.

There is a very extensive system of sinews connected severally with the feet, the hands, the ribs, the shoulder-blades, the neck, and the arms.

All animals supplied with blood are furnished with sinews; but in the case of animals that have no flexures to their limbs, but are, in fact, destitute of either feet or hands, the sinews are fine and inconspicuous; and so, as might have been anticipated, the sinews in the fish are chiefly discernible in connexion with the fin.

6

The Ines (or fibrous connective tissue) is a something intermediate between sinew and vein. Some of them are supplied with fluid, the lymph; and they pass from sinew to vein and from vein to sinew.

There is another kind of Ines or fibre that is found in blood, but not in the blood of all animals alike. If this fibre be left in the blood, the blood will coagulate; if it be removed or extracted, the blood is found to be incapable of coagulation.

While, however, this fibrous matter is found in the blood of the great.